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EDITORIAL

VIRUS DISEASES OF PLANTS

VIRUS diseases of plants like similar maladies in animals are transmissible or infectious complaints whose cause is the presence in the system of an invisible material conveyed from another individual in which it is already present. For convenience of description the material is called a virus but of its exact nature but little is so far known. A virus has so far escaped revelation under the highest magnification. It is this evasive property of the virus that leads one to the suspicion that it may be a fluid substance. There are certain characteristics, however, in which it resembles a living organism. Like unicellular organisms it can often be removed from fluids containing it by a process of filtration just as it is possible to take the bacteria from water by the action of a filter, but the filtering medium must be a very much less porous one to retain a virus than that required for the retention of bacteria. The material extracted or filtered out by appropriate means possesses the infective property. What has so far been discovered by science concerning a virus is mostly a knowledge of its infective property, such as the symptoms produced by it when in the body juices of animal or plant. Of the length of time during which the virus remains active or capable of producing infection and of how long a particular virus takes to produce its characteristic symptoms in the patient we have some knowledge. Some viruses have been proved to remain infective for over thirty years. The influence of temperature upon many viruses is interesting. Whilst one virus may have its infective property entirely destroyed by subjecting it to a moderate temperature

yet another may be able to withstand heat a little less than that of boiling water, actual boiling however renders them all non-infective.

The manifestations or symptoms resulting from the presence of a virus within a host plant have often been known longer than the etiology of the disease. The methods of inoculation or transmission of the virus from one subject to another are various. In all cases the virus must be brought into actual contact with the subject so as to gain entrance to its cell juices, to result in infection. Frequently the virus is transmitted by means of insects, in some cases by mere body contact of an insect, and here it would seem that the virus is carried and gains entrance to the juices of the plants through damage by the insect to the minute hairs that cover the plant leaves. The mere knocking by the wind of the leaves of an infected plant against those of an uninfected neighbour would in such a case produce infection. A virus infection of tobacco producing "mosaic disease" is transmitted in this way. The disease is not uncommon in Ceylon and as its name implies a manifestation of it is a mottled appearance of the leaf due to mixed areas of a light and dark-green colour. The virus is one that has been considerably studied. It is of longevity and has been found capable of remaining infective for at least thirty-one years. The reduction in yield of an infected crop may be over thirty per cent. and in value very much more.

The Bunchy Top Disease of plantains which is found almost everywhere in Ceylon is a virus disease carried by aphides or green fly. The only part of the Island where the disease is not found among the plantain crop is the Magam Pattu of the Hambantota District in the Southern Province.

In some cases a virus undergoes a necessary period of sojourn in the alimentary tract of the insect between the time of the juices containing it being sucked from one plant and transmitted through the mouth parts of the insect when sucking another. A small fruit fly sucks the juices of tomato plants infected with a virus disease known by the descriptive title of "spotted wilt". When this fly later sucks the juices of a healthy plant it does not transmit the infection. When however the grub in the life history of this fly feeds on an infected plant and then develops later into a winged fly this latter inoculates a healthy plant when it pierces the tissues with its proboscis. Such are some of the discoveries concerning virus diseases. We have these virus diseases amongst our crops in Ceylon. The control of virus diseases would seem to lie in the production by the plant-breeder of varieties of plants immune to the infection.

THE CULTIVATION OF FRUITS IN CEYLON WITH CULTURAL DETAILS—VIII

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GROUP C

SOME FURTHER FRUITS FOR MID-COUNTRY WET ZONE (1,500-4,000 FEET)

(4) AVOCADO PEAR (*Persea gratissima*)—known also as the Spanish Pear and Soldier's Butter, but most commonly as the Avocado—or Alligator Pear and Et-pera, S. Though generally classified as a fruit tree it is rather as a salad that it is appreciated than as a dessert fruit. The Western tropics and parts of the Eastern tropics hold the fruit in much esteem on account of its nutritious properties, and it is accordingly commonly grown in Central America, West Indies, Mexico and Hawaii.

Compared to most others the Avocado is a new fruit of the tropics and certainly as yet not well known or sufficiently appreciated in Ceylon. The actual date of its introduction here is in doubt, but the variety found in Ceylon thrives excellently at elevations between 1,000 to 3,000 feet in the moist zone. America has made great strides in the culture of the Avocado and the Californian Avocado Association, organised in 1914, has exerted considerable influence in effecting its improvement. The United States Department of Agriculture had previously, however, through its Agricultural Explorers, obtained the seed and bud material of the best varieties from all sources in order to give the industry the best possible start. The Association renders valuable services in studying the numerous varieties in cultivation, recommending only those of standing merit and suitability for commercial planting, and its literature affords a valuable contribution and is of great assistance to the grower. A Co-operating Marketing Agency, the Calavo Growers of California, was founded in 1924 to cope with the marketing of the rapidly increasing crops and is functioning satisfactorily at the present time. Hawaii too has an organisation and produces excellent fruit for export to American ports. The existence of these associations shows with what zest this fruit is being encouraged in America.

There are two distinct species of avocado—*Avocado gratissima* (syn. *Avocado americana*) embracing the West Indian and Guatemalan types of which fruit the Ceylon plant is a variation though not a good one, and *Avocado drymifolia* of the Mexican highlands, a tree not yet known to Ceylon except at Peradeniya and which is a more hardy plant, sub-tropical, and of probable utility in the high elevations of Ceylon. There are many cultivated forms of each group, the former being characterised in general by large fruits with a thick skin of leathery texture and the latter by smaller fruits with a thin membranous skin, but both species vary in size, shape and colour, from one to three pounds in weight, from round to oval and pear shaped fruit, and in colour from green to purplish black. The fruit is single seeded, the fleshy edible portion being that between the seed and the skin. The flesh is of buttery consistency, of nutty flavour, cream coloured, and contains a large percentage of vegetable oil, in some cases as much as 18 per cent., very appetising and most nourishing and is eaten by scooping the flesh out with a spoon and partaken of either plain or flavoured with salt and pepper, the latter being the usual way.

The tree attains a moderate height of 20 to 25 feet, the West Indian varieties being suited to an elevation of 1,000 feet to 3,000 feet in the moist regions and the Mexican varieties at elevations of 2,500 feet to 5,000 feet. Dry atmospheric conditions are not suited to either, and exposed windy sites should be avoided. The nature of soil required fortunately presents no difficulties since it thrives on a wide range of soils varying from that of a light sandy nature to a heavy but not too clayey loam. A good deep soil of medium texture with good drainage will produce the best results, and sites with a subsoil of hard pan or rock less than 4 feet below surface should be avoided.

Propagation locally is by seed but the Avocado does not as a rule come true to type. Propagation should be by budding and that on the rectangular patch or shield system as employed for rubber which has to date been more successful at Peradeniya than either grafting or "T" budding. The local common variety is a robust tree and admirably answers the purpose of a stock plant for the West Indian varieties for the elevations given. For an elevation of 4,000 to 5,000 feet the Mexican stock is required and application for seeds or plants of this has been made to America for trial in the up-country districts of Ceylon.

The seed is large, often 2 inches in diameter, and should be sown on removal from the fruit and planted either singly in large bamboo pots or preferably in well prepared beds of loose

and sandy soil at distances of one foot apart and 18 inches between the rows, care being taken that the pointed end of the seed is uppermost.

Germination is fairly rapid and the seedlings are ready for removal to permanent sites or for budding at 6 to 8 months of age, at which age the seedling has attained a stem diameter of fully half an inch. Shield budding is recommended, the buds being obtained from well ripened wood and selection made of the more plump buds. The bud shield should be not less than $1\frac{1}{2}$ inches in length, the use of smaller wood having been proved to be much less successful. The subsequent procedure is that adopted for citrus budding and the budded seedlings should be ready for transplanting to the orchard or compound at six months from budding.

Planting distances of 21 ft. by 21 ft. are normally sufficient but certain varieties and seedlings require more space and 25 ft. by 25 ft. should be the maximum.

There is sometimes a tendency, mostly with seedlings however, for the plant to shoot up and not spread as it should. The terminal shoot of such plants should therefore be cut back to encourage a branching habit. Pruning is not often required except in the removal of weakly branches or any dead wood. All cuts made should be clean and carefully attended to and painted with a wood preservative. In Ceylon the tree is normally of healthy growth but is subject to attack by stem boring caterpillar, thrips, and mealy bug. These troubles are remedied by cutting out the growth affected by the stem borer, and by emulsion sprays for leaf attacks.

It should be borne in mind that the Avocado is a rapid grower and a gross feeder and good supplies of well-rotted manure should be forked into the soil around the tree at regular intervals, preferably a good dressing just prior to each monsoon.

With regard to cropping, a mature tree will give from a few dozen to many hundreds of fruit, usually according to size of fruit. Varieties producing very large fruit are considered good bearers if 4 to 5 dozen fruits are obtained, but on the other hand a full grown seedling tree will give nearly 1,000 small fruits. The majority of the best varieties in commercial cultivation however give medium sized fruits—the market requisite —and 200 to 300 fruits can be considered a good crop for a normal sized mature tree.

The varieties mostly in favour with growers, and recommended for Ceylon are the "Trapp", "Pollock", "Dickinson", "Dutton", "Lyon", "Mayapan", and "Winslowson" of the thick skinned West Indian and Guatemalan varieties and

"Gantor", "Gottfried", "Northrop", "Puebla", among the Mexican and colder region varieties. The purple or maroon coloured Avocado fruits are at present a novelty in Ceylon but there are many varieties bearing such, a tree of the "Gottfried" having recently fruited at Peradeniya the fruit being of most attractive colour and the pulp of acceptable nutty flavour. The purple skinned varieties of the above are "Dickinson", "Dutton", "Mayapan", "Gottfried", "Northrop" and "Puebla".

(5) CEYLON GOOSEBERRY (*Aberia Gardneri*).—This is essentially a Ceylon fruit being endemic to the moist parts of the Island between the elevation of 1,000 to 4,000 feet, and known as the Ket-ambella, S. It is not however generally well known. Under cultivation the fruit is very acceptable, being edible and pleasantly acid and suitable for dessert purposes as well as for tarts, jams and jellies. The velvety and hairy skin easily peels off and this must be removed when using the fruit either for dessert or for preserves.

The plant producing the fruit attains only the size of a small tree or large shrub rarely exceeding 15 feet in height, and is of a very spreading habit with slender drooping branches which bear, in favourable seasons, enormous crops of fruit.

The leaves are small and the shrub is generally of very ornamental appearance. The fruits are round with brownish purple velvety skin and averaging one inch or slightly more in diameter. The pulp is purplish in colour and is sweet and luscious when properly ripe, resembling both in form, texture and flavour the English Gooseberry. By attention to selection this fruit can doubtlessly be much improved and made well worth cultivating in the intermediate moist zone of Ceylon.

The plant grows freely in normal soils and particularly so in a loamy sand with good drainage. The flowers are dicœcious—that is the male and female flowers are produced on separate trees—so that plantings should be made collectively or at least in twos and threes though it has been reported that isolated plants here and there are sometimes fruitful.

Propagation is normally by seed which should be sown in boxes under cover. Germination is free and growth fairly rapid, and seedlings should be potted up when 2 to 3 months old. Permanent plantings can be made at one year from sowing of the seed and in transplanting, distances of 12 feet by 12 feet should be given.

Fruits can be expected in 3 to 4 years from planting, the season being August and September. Being endemic to Ceylon it is not a fruit generally cultivated outside the Island, though it

is found in a few gardens in the Western tropics, in Cuba and Florida, and has within recent times been introduced to the Philippines also.

As there may be instances here and there of a tree with perfect flowers and thus not requiring cross pollination, such a tree should be propagated vegetatively always provided the fruit is of good quality as such a tree would be of value in the improvement of this fruit.

(6) GUAVA (*Psidium Guajava*).—A genus of over 100 species closely allied to the Pomegranate and of which the Guava now referred to is probably the most useful. A wild form occurs in Ceylon and is known as the Pera, or Embul Pera S., and Koiya-pallam, T., but there are many cultivated forms of the species generally classified as the sour, sweet and red-fleshed, and in shape varying from round to oval, pear shaped, and warty furrowed fruits.

The home of the Guava is in tropical America and from thence it has spread and naturalised itself in many parts of the tropics including Ceylon, India and Hawaii. It is cultivated in a range of climates including the south of France and Italy and North Africa and is undoubtedly a very hardy plant. In Ceylon the tree grows from sea level to 4,000 to 5,000 feet in the moist and in semi-dry zones.

It can be termed a small tree as it rarely exceeds 20 to 25 feet in height, and is noticeable for its greenish brown smooth and scaly bark. The fruit of the horticultural forms varies in colour and size but is generally a light green to yellow and 3 to 4 inches in diameter. The flesh is juicy and usually white, but in some forms pink to salmon red, and the flavour sweet, slightly musky, and aromatic. Though not a particularly attractive dessert fruit it is appreciated when stewed or preserved and is unrivalled for jellies, guava jelly being the chief form in which the guava is commercially utilised.

The tree can be grown on almost any type of soil even to a very light sandy soil, but grows best in a normally good soil with some humus content. In general practice propagation is by seed, but where one possesses a good variety it should be propagated by cuttings, gootee, or by layering of the lower branches. Budding or grafting has not yet been tried at Peradeniya and the nature of the budwood indicates that such would be difficult. Florida growers have however budded this on the shield bud system using own seedlings as a stock and by budding in the cool months whilst the stock plant is very young.

Mature budwood should be used, that just turning in colour from green to brown and bud shields of at least 1 inch in length being the best. Another method, not usually employed, but applicable to this and certain other fruit trees, is to sever a few of the surface roots with an axe or sharp knife, letting the severed end of the roots remain where they are until young shoots form at the severed end. When these shoots attain a height of 8 inches to 10 inches the severed root should then be lifted and planted direct into a permanent position.

Propagation by seed is however not to be despised and though the seed retains its vitality over a long period it is advisable to sow when fresh, either in boxes or pans filled with a good light and loamy compost. Germination is not rapid and often four months will elapse before the seedlings are sufficiently large to put into pots, this being done when the seedling is 2 inches to 3 inches in height. At no time should the seedlings be over watered, keeping rather on the dry side, and on attaining a height of 12 inches or so the potted plants can be carefully transferred to permanent positions.

A distance of 15 feet by 15 feet apart is recommended for intermediate elevations and 18 feet by 18 feet for low-country conditions, holes being previously well prepared and a quantity of cattle manure added to the soil. Regular manuring and mulching in dry weather is advocated for the first few years and little pruning is called for.

The tree is a heavy cropper as a rule and carries its fruit over a fairly extensive period, individual trees varying in their fruiting season which often extends from August to January in Ceylon.

Seedling plants bear at about four years of age, but layered plants or rooted cuttings bear at an earlier age. Plants will continue to bear good crops over a period extending from 20 to 25 years.

The Guava is subject to periodical attacks of leaf and fruit disease and from leaf eating caterpillars and scale but the normal sprays as recommended for fruits previously dealt with will remedy these difficulties if regularly applied in the early stages of attack.

(7) PASSION FRUIT (*Passiflora edulis*).—A genus of plants covering a large number of species estimated to be as many as 275.

Many species are, in temperate countries, grown purely for ornamental purposes but those commonly found in the tropics are grown for their edible fruit. The purple Passion fruit of Brazil here referred to is also known as the "Sweet cup" and

sometimes as the "Purple Granadilla" (not to be confused with the yellow "Giant Granadilla", *Passiflora quadrangularis* known locally as the Rata puhul, S.) and is suited to elevations of 2,000 feet upwards of both moist and semi-dry districts.

The plant is a strong, rapid growing, evergreen, climbing vine with large three lobed leaves, and bears oval fruits the size of a fairly large hen's egg and of a deep purple colour when ripe. The outer skin or shell is brittle and within are numerous seeds surrounded by yellowish pulp, very juicy and aromatic and of an acid flavour. The pulp can be eaten as taken from the fruit or as a refreshing drink by adding sugar or by beating it up in a glass of water to which a small pinch of bicarbonate of soda is added. Its other uses are in flavouring and in cake icing, for confectionary, and for trifles, and is also much appreciated as one of the ingredients of a mixed fruit salad.

The purple variety can be found cultivated in a number of up-country gardens but nowhere in Ceylon is it grown on a large scale. Commercial cultivation of the fruit is practised in Queensland and New South Wales, and in the North Island of New Zealand, and on a smaller scale in the Mediterranean regions, and in the Southern United States.

Moist soils are suited to the passion fruit and even a poor soil suffices if kept in good tilth, regularly manured and good drainage afforded. A good dressing of lime to the soil before planting can be specially recommended. Generally speaking the vine thrives best in a light soil of good quality. A favourable aspect is another important factor that allowing of plenty of sunshine and protected from very strong winds being the most favourable.

The plants can be raised from either seed or cuttings, the latter being the usual procedure, selecting matured shoots of 8 to 9 inches in length and inserting in a well prepared bed of sandy soil. If seeds are used these should be from selected and well ripened fruits but on expressing such from the pulp they should not be washed, but mixed with sand and dried. This both separates the seed and prevents their becoming infected with mildew which otherwise occurs if the seed is washed. Sowing *in situ* or in nursery beds with later thinning out is recommended by some and in boxes or pans by others, but since the vine objects to too much root disturbance, sowing in nursery beds is generally preferred.

The seeds should be sown about half an inch deep and one inch apart, later thinning out to 3 inches apart. The seedling nursery bed plants should be put out in permanent quarters at from 6 to 8 months after sowing. A longer period is required if seed be sown in boxes.

Being a vine, some kind of support is needed for it and a good stout trellis of 5 to 6 feet in height answers the purpose, the vines being planted 15 ft. by 20 ft. apart and trained along the wires and supports of the trellis. Grown thus it is necessary that the vine be trained fanwise on the trellis and not allowed to run wild. The trained stem will then form laterals from which the fruit is borne. Regular pruning is necessary as the vine bears fruit only on the new wood and each season the laterals should be cut back to within 2 or 3 buds from the main stems to encourage further new wood and crops.

The Passion fruit plant begins to bear very early and will, if a suitable position and elevation and attention to pruning be afforded, produce two crops a year. A small amount of fruit can be expected in the first year from planting but the vine is short lived and the bearing life of the plant may be considered to be from the second to the sixth year. For this reason the fruit is often cultivated in citrus orchards in Australia being interplanted between young and newly planted Citrus trees. Since it bears fruit so early a grower uses this as a catch crop, realising sufficient from his Passion fruit to cover the working costs of the Citrus orchard in which these are planted. The full spacing is not utilised by the Citrus until the trees are 5 or 6 years, at which age the Passion vine loses vigour and is removed.

A yellow fruiting variety of the Passion fruit is occasionally met with in low-country gardens and is of excellent flavour, the fruit also being larger than those of the purple variety. It is exceptionally robust in growth and requires ample space in which to roam and is specially adapted, apart from its fruiting properties, for forming a very effective screen. This variety too is propagated both by seed and from cuttings and its culture is similar to that of the purple variety, but it does not stand such severe pruning as the purple and must be allowed to roam to a larger extent.

The flowers of some of the Passifloras are protandrous—the anthers having shed their pollen before the stigmas are receptive —and it is often necessary to hand pollinate the flowers by means of a small camel hair brush to obtain good crops, this being carried out on dry days during the mid-day hours. Others are, however, hermaphrodite and the purple variety appears to be so but with the low-country yellow variety hand pollination is often necessary.

The passion fruit vine is fortunately fairly free from pests and diseases, but leaf eating caterpillars and sucking bugs are occasionally troublesome. Such can be checked by a periodical use of Paris green or arsenate of lead applied in the form of a very fine spray.

Peristeria elata Hook

PERISTERIA ELATA HOOK

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THIS interesting epiphyte is indigenous to Central America and is known there by the name 'El Spirito Santo', the "Holy Ghost", or "Dove Orchid", by reason of the resemblance of the column of the flower with its beaked anther and side wings to the form of a dove.

It is a strong growing handsome orchid with striated green-coloured large fleshy pseudobulbs of the size of turkeys' eggs. The plant bears three to five lanceolate strongly ribbed plicate leaves, which often attain a height of three feet or more, and a width of about six inches.

The flower stalk rises from the base of the mature pseudo-bulb, sometimes to a height of five or six feet. The flowers are borne on the upper portion of this stalk, and are almost globular, about an inch and a half across, waxy-white with lilac specks on the base of the lip and inner side of the wings, and strongly scented.

Culture.—Though the plant is an epiphyte it requires a certain amount of the treatment given to terrestrial species. It resents disturbance unless the plant has overgrown its receptacle or the compost has become quite impoverished or sour. Small divisions of the plant or back leafless pseudobulbs with a few roots to each are carefully removed and used for the purpose of propagation.

Young healthy plants are produced on the uppermost leaf scars of the leafless pseudobulbs when severed from the main clump and potted. These small plants or the pseudobulbs themselves should be inserted in six inch pots first in a porous mixture made up of equal parts of flaky leaf soil or turfy soil, well-decomposed farmyard manure, and coarse sand. In the course of potting a handful of crushed charcoal may be added to ensure porosity. The young plant should not be buried too deeply. It only requires the root system to be properly spread

out in the pot, then covered and given a layer of fine compost, up to about an inch from the top of the pot, which should eventually be filled in with pieces of crushed bone, brick and charcoal to enable free access of air and light into the pot. This layer will also serve as a good rooting medium and prevent the soil from being washed away during heavy rain when placed out of doors.

The plant requires a decided rest after flowering, without this it is almost impossible to get it to bloom regularly. To secure this after the flowers are over very little water should be given, only sufficient to prevent the pseudobulbs from shrinking. During the growing season the plant requires a liberal supply of water and should be placed under the shade of tall trees.

A warm, moist atmosphere is very desirable while the plant is in active growth, but avoid placing it in direct sun as the fleshy pseudobulbs are liable to be scorched.

THE CROTON OIL TREE

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DESCRIPTION

Croton tiglium, Sinh. Jayapala, Tam. Nerwallam, is a small tree native to India and Malaya. The tree has alternate oblong leaves and small flowers in loose racemes. The seed is borne in capsules each of which contains three ovoid seeds about half an inch long.

Croton tiglium should not be confused with the decorative horticultural plant commonly known by the name of "Croton".

CLIMATE AND SOIL

Croton tiglium has been introduced into many tropical countries. It is said to be cultivated throughout the greater part of India where it grows in the poorest soils from sea level up to 3,000 feet. It is probable that it will thrive in Ceylon up to this elevation or even higher. Although found in most of the mid-country and low-country districts of the wet zone it is believed that for the production of sound seed the semi-dry districts are preferable. It is to be noted, for instance, that in the Central Province the plant is chiefly cultivated in Teldeniya, Matale North, and the drier parts of Galagedera.

It is also found in the dry zone.

Good drainage is important.

Trials in old rubber or land previously occupied by rubber or coconut have not been successful.

PLANTING AND CULTIVATION

The plant may be successfully propagated by sowing "seed at stake", two or three seeds in a hole, and this is probably the cheapest method. Alternatively small plants may be transplanted from a nursery when three or four inches high. One grower recommends putting seed in a nursery bed for 10 to 12 days and then planting out before the seeds germinate.

The trees may be spaced 10 feet by 10 feet or 12 feet by 12 feet, the former distance giving 435 trees per acre and the latter 302 trees. Some growers advocate planting 15 feet by 15 feet but from observation at Peradeniya 12 feet by 12 feet would appear ample.

Holes should be dug and should not be less than 18 inches wide and deep. The planting season will vary according to the districts, planting should of course be done at the beginning of a wet season.

Shade is not necessary, though on the Experiment Station, Peradeniya a row of Croton trees which adjoin and obtain some shade from large dadaps serving as shade for an adjoining block of cacao appear rather healthier than those with no shade.

Apart from weeding very little further attention is required, until the trees come into bearing.

PRUNING

At Peradeniya a number of trees have been pollarded to about 6 feet. This has produced a lower and more spreading tree from which it is easier to gather the crop. The yield from such pollarded trees has been found to be fully equal to, or slightly larger than, from unpollarded trees, and the operation can therefore be recommended.

Apart from the removal of dead wood no other pruning would appear to be necessary.

PREPARATION FOR THE MARKET

The extraction of the oil is not as a rule undertaken by growers in Ceylon, and consequently the only form of preparation required is the shelling of the seeds (i.e. the removal of the seed capsule) and the careful removal by winnowing and hand picking of all shrivelled and unsound seed.

Seed is shipped to Europe as such and the oil there extracted in mills. The Director of the Imperial Institute, London states "It appears to be customary for firms in this country to prepare the oil themselves from imported seed. Very little, if any, Croton oil is imported here". Sir George Watt in "The Commercial Products of India", however, states that it is better to express the oil before transit as much is lost on the voyage. In India the oil is extracted by cold pressure in the same manner as castor oil. When run off the oil is allowed to stand for 15 days and then filtered through charcoal before bottling.

USES

The only use for Croton oil of which authoritative information has been received is the medicinal one. The oil is a very powerful purgative and is poisonous in excess. It should be handled with care as it is a powerful irritant to the skin.

Croton oil is considerably used by local Ayurvedic Physicians. There is a constant though limited demand in Europe for seed for the extraction of oil for medicinal purposes.

PESTS AND DISEASES

The most serious insect pest is the caterpillar of *Amyna punctum* which attacks the leaves and sometimes completely defoliates the trees. The caterpillar also attacks the Keppitiya tree, *Croton lacciferus*. Complaints of attack by this caterpillar go back for fifty years, but infestation appears to be local and spasmodic. The simplest method of dealing with the caterpillars is to shake them off the trees, or make them drop off by dusting with lime or ashes, and then collect them up from the ground and destroy them.

On trees weakened by caterpillar attacks infestation by the black scale, *Saissetia nigra*, has been recorded.

Of fungus diseases *Cercospora tiglii*, a disease which attacks the seed capsules, is the most common. This disease does not usually penetrate very deep but may form an additional limiting factor to the production of sound seed in the wetter districts.

The root disease *Fomes lignosus* has been recorded on *Croton tiglium*.

CROPPING SEASON

The climate in many parts of Ceylon is so even that in the case of many crops there is no very sharply defined season. This remark applies to *Croton* and it is quite common to see ripe fruits and flowers on the trees at the same time. At Peradeniya the bulk of the crop is gathered between June and November. A Galagedera grower gives the main crop season as being between July and January. In the Teldeniya district harvesting is said to begin in July and August. A small subsidiary crop is usually gathered at Peradeniya about March but this crop almost invariably contains a large proportion of empty or partially empty seed capsules. The same experience is reported from Galagedera.

YIELDS

The first crop may be expected in two years after planting.

Information on yields is somewhat conflicting. A yield of $2\frac{1}{2}$ cwt. of seed per acre is reported from a $2\frac{1}{2}$ year old clearing containing a large number of vacancies. An area of cacao which was thickly interplanted with Croton giving 800 Croton trees per acre gave 2 cwt. of seed per acre in the first crop season. Estimates of an average crop from mature *Croton* trees vary between 3 and 12 cwt. per acre, but the higher rate is not supported by actual yield figures. It would be safe to say that a yield of 2 cwt. could be expected at the first crop and a yield of from 3 to 6 cwt. of seed per acre from mature trees. It is not uncommon at Peradeniya to find that between 30 per cent. and 40

per cent. of the capsules harvested are empty or light and cannot be used for sowing purposes. This trouble has been experienced in other wet districts. In the drier districts however little trouble from light seed is reported.

At Peradeniya the out-turn of weight of seed to weight of dry seed capsules has been found to be 45 per cent. to 50 per cent., but at Galagedera where trouble from light seed is not experienced the out-turn is stated to be from 56 per cent. to 57 per cent.

The average number of seed capsules in 1 lb is about 600.

The average number of good clean seeds in 1 lb has been found to be 1,554.

PRICES AND COMMERCIAL PROSPECTS

For many years the price of *Croton* seed has been subject to violent fluctuations. The seed is only used for medicinal purposes and being a very powerful drug only used in small quantities the demand is naturally limited. On the other hand the crop is so easily cultivated and comes into bearing so quickly that any rise in price immediately results in further planting with the result that overproduction follows.

In 1885 a correspondent to *The Tropical Agriculturist* commented on the fact that the price had recently fallen from 56 to 40 shillings per cwt. In 1886 prices between 48 and 70 shillings per cwt. were quoted, while by 1887 the price had fallen to 8 shillings per cwt. or less.

Similar fluctuations have since occurred periodically.

On April 21st, 1931 the Director of the Imperial Institute reported "There is a more or less regular demand for seed in the United Kingdom. Latterly there has been a severe shortage, and for the past six months the value of the seed in London has been about 230 and 290 shillings per cwt., that of the oil being about 14 shillings to 15 shillings per lb. The 'normal' values of the seed and of the oil are about 30 shillings, 40 shillings per cwt., and 3 shillings and nine pence per lb., respectively."

"Recent quotations were 280 shillings per cwt. for the seed and 135 shillings and 4 pence per lb. for the oil, and according to firms that have been consulted by the Institute there are indications that conditions in the market are becoming easier."

The above are London prices. The Colombo Customs export figures for the last three years were:—

1929,	338	cwt. exported	valued	@ Rs.	6,778·00 = Rs.	20	per	cwt.
1930,	209	,,	,,	@ ,,	21,197·00 = ,,	101	,,	,,
1931,	377	,,	,,	@ ,,	28,732·00 = ,,	76	,,	,,

Mr. F. J. Holloway supplied the following information in July, 1932. "The highest price obtained in 1930 was Rs. 130/-. 1931, Rs. 120/-, January to May 1932 up to Rs. 120/-. Just now it is round about Rs. 100/-, but a fall in price may be expected this year as a good deal of Croton was planted on the Matale side in 1930 and 1931".

There is little doubt that fairly extensive planting of *Croton* has taken place in the last year or two and that a rapid fall in price is almost inevitable.

The Divisional Agricultural Officer, South-Western Division reported in 1931 "Ratnapura district gets its supply of seed from retail merchants in Colombo at Re. 1/- per lb. which is sold to local medical practitioners at Rs. 2/-. The Colombo merchants import the seed from India. It is said that 15 to 20 lb. are annually sold by Ratnapura dealers." It would appear that there is a small import trade from India which seems quite unnecessary in view of the amount exported from the Island.

The Divisional Agricultural Officer, Central Division, reports as follows: "In 1930 there occurred an unprecedented demand for *Croton* seed and prices rose from Rs. 15/- to Rs. 25/- per cwt. (which were then ruling prices for many years) to over Rs. 150/- per cwt. With this sudden rise in prices village growers in the Teldeniya district have taken up the cultivation."

There appears every probability that past fluctuations in the price of Croton seed will recur again in the future and the planting of extensive areas cannot be recommended.

CROTON AS AN INTERCROP

Croton may be planted as a catch crop in young cacao, and if planted sufficiently early might serve as temporary shade for the young cacao plants. The tree scarcely attains sufficient size to serve as a permanent shade tree for cacao. A line of Croton with the plants 10 to 12 feet apart might be planted between each cacao row.

Croton may also be planted among coffee and in this case the tree appears quite suitable as a permanent shade. Probably a row of *Croton* trees up alternate coffee rows would provide sufficient shade for the coffee or the *Croton* could be given the same spacing as the coffee and alternate plants or alternate rows cut out later.

ACKNOWLEDGMENT

The writer wishes to express his indebtedness to Mr. F. J. Holloway of Trafford Hill, Galagedera, for much valuable information furnished, and to the Divisional Agricultural Officers for reports sent during 1931.

CONTRIBUTIONS FROM THE RUBBER RESEARCH SCHEME (CEYLON)

ALTERNATIVE FORMS OF RAW RUBBER

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THE present unremunerative condition of the rubber plantation industry has compelled producers to scrutinize costs of production very carefully and the question is frequently asked whether raw rubber cannot be marketed in some cheaper form than the present standard grades, smoked sheet and pale crepe. Although the question is mainly raised on the score of cost there is also the feeling that a great deal of trouble is taken to turn out rubber of good appearance whilst frequently some minor defect in appearance leads to a reduction in market value out of proportion to the effect of the blemish on the quality of the rubber. Planters also know that manufacturers are not altogether satisfied with the properties of plantation rubber and the question is sometimes put in the form of whether some cheaper *and* better form of manufacture can be devised.

The writer has spoken on matters arising from these questions at several Planters' meetings during the past few months and it is considered to be of interest to review the subject rather more fully than has been possible on those occasions.

PRESENT METHODS OF MANUFACTURE

It is considered necessary to separate the two questions enumerated above (a) whether cheaper methods can be devised; (b) whether methods giving a better product can be devised. In succeeding paragraphs it will be shown that existing methods can probably be adjusted to give a better product than at present and that there may be scope for marketing rubber in forms other than smoked sheet and crepe but it will become evident that alternative methods of preparation are not likely to decrease costs of manufacture.

In raising the question of adopting cheaper processes planters sometimes have in mind the possibility of reverting to a more primitive product such as the slabs of coagulum produced by the peasants of Sumatra and Borneo; the rather more refined "slab rubber" which has been shipped from certain estates to

fill special contracts; and the balls of "fine hard Para" which form the standard product of Brazil. It is overlooked that each of these products has to be milled and dried before use in manufacturing processes and that the effect of marketing these grades would merely be to transfer the milling process from the producer to the user. Since coagulum gradually hardens on keeping, the actual cost of milling would be correspondingly greater than that of machining raw coagulum.

For a market with an annual turnover exceeding half a million tons, such as the raw rubber market, it appears to be essential or at least a great convenience that the material should be marketed in a relatively dry condition in order to avoid contiual disputes regarding allowances to be made for variation of moisture content.

Consideration of the processes for making smoked sheet and crepe shows that the purpose of each type of machining is to bring the coagulum into a suitable form for efficient drying. In the case of sheet rubber the coagulum is squeezed out sufficiently thin to be dried reasonably rapidly over a wood fire. In crepe manufacture the rubber is rolled thinner since it is to be dried without heat and washing must be more thorough to prevent development of moulds, etc. in the absence of wood smoke. The colour of the material is of importance for certain uses so sodium bisulphite is added to crepe rubber to prevent darkening during drying and storage. It must be admitted that sodium bisulphite is not very effective in this direction since there is not much difference in the colour of crepe prepared with and without bisulphite after a year's storage.

If it is agreed that raw rubber can most conveniently be marketed in a dry form, (except for special products such as preserved latex) then the present form of manufacture must be regarded as quite logical and the only question is whether some cheaper way of preparing a dry product can be devised. In comparing the cost of present methods with possible alternatives the planter, who may unavoidably be producing under relatively inefficient conditions, is inclined to base his calculations on costs in his own factory whereas it would be more reasonable to take as a basis of comparison the cost of preparation of smoked sheet and crepe rubber under the most efficient conditions. Without going into any details the writer expresses the opinion that costs of present methods of manufacture under moderately efficient conditions need not exceed Re. 1·00 per lb. for smoked sheet and Rs. 1·75 per lb. for crepe, without cost of packing cases but including depreciation on the basis of complete renewal of machinery every ten years. At present market prices this may appear a substantial item in cost of production but it is difficult to visualise an alternative process of manufacture which could be

expected to reduce the cost materially. Reduction of manufacturing costs is more likely to result from the use of the most efficient equipment and the concentration of manufacture in comparatively large factories.

SELLING ON APPEARANCE

The writer holds no brief for the practice of selling rubber on appearance and agrees that it would be much more satisfactory to market the product on the basis of quality as indicated by physical tests but the present system of grading can only be altered when both manufacturer and producer are in a position to deal on the basis of quality rather than appearance. If a Ceylon producer was offered a contract for rubber with a time of vulcanisation of 100-120 minutes, a mastication number of 80-100, and ageing properties showing less than 10 per cent. reduction of tensile strength after 96 hours' artificial ageing, all under specified conditions, he would not be in a position to accept it at the present time. There is a growing tendency for manufacturers to contract for the product of estates which they know suits their purpose and this may gradually develop into a system of selling on quality rather than appearance.

Until quality replaces appearance as a basis of sale it is fairly logical for the buyer to assume that rubber of good appearance results from careful and uniform methods of manufacture and that defects such as discolouration of crepe and mould, rust, bubbles, etc. in smoked sheet indicate irregularities in preparation which may lead to difficulties in subsequent manufacturing operations, and to value the product accordingly.

It is not so much the system of selling on appearance which causes dissatisfaction to producers as the comparative abuse of the system. The standard basis of sale on contract is "fair average quality" (appearance), which should be a fairly stable standard, but there is too great a tendency to vary the standard according to market conditions. At the present time when the current market price stands at several cents below the figure at which contracts were booked some months ago, the buyer is inclined to translate F. A. Q. as "superfine" quality and to reject rubber which is genuinely fair average quality. In fairness to the manufacturer it must be stated that many of the discounts which are imposed for slight blemishes in the rubber represent so much extra profit to the dealer and are not reflected in the price which the user pays for his supplies.

ADJUSTMENT OF EXISTING PROCESSES

The most disappointing factor of present methods of manufacture and marketing is that, in spite of the care taken to produce rubber of good appearance, the manufacturer is not fully satisfied with the properties of high grade plantation

rubber. His main complaint is that there is too much variation in the properties of different batches of the material. Variation in rate of vulcanisation and in ageing properties is less important now than formerly since these differences are largely adjusted by the use of accelerators and anti-oxidants in manufacturing processes. The factor which causes most trouble is the variation in hardness of the rubber, that is variation in the amount of milling required to soften the rubber sufficiently to mix in other compounding ingredients. When it is stated that occasional batches of rubber may vary by 50 per cent. from the average it will be understood that the difficulty is a real one.

Unfortunately for the plantation industry the manufacturer is inclined to meet the difficulty by replacing a proportion of high grade rubber by lower grade material such as "reclaim" and "Singapore blanket" which he knows to be uniformly soft. If the uniformity of plantation rubber could be relied on it would do much to stimulate the use of increased quantities of the material.

Experiments carried out by the Rubber Research Scheme [1] have shown that variation in the product of an individual estate can be limited to about 10-12½ per cent. on either side of the mean by careful standardisation of manufacture but there is also considerable variation in the properties of rubber from different estates arising from inherent differences in the latex. The variability of plantation rubber could be greatly reduced by concentrating manufacture in large factories so that latex from a number of estates could be bulked together.

The Research Scheme has recently been experimenting on hot water treatment of crepe rubber with a view to improving plasticity. Tests carried out up to the present have given satisfactory results and it seems likely that this will prove a practicable and economical method for reducing variability in this direction. Incidentally, and perhaps of greater interest to producers, the treatment minimises discolouration of crepe rubber during drying and storage. Methods are also being considered for preparing a hard grade of rubber which is useful for certain purposes and rubber with a low content of serum substances for electrical insulation.

The possibility of marketing unsmoked sheet was investigated some time ago, in view of the increasing scarcity of firewood for smoking [2]. Since it is considered impracticable to dry sheet rubber at ordinary temperature under estate conditions the possible advantage of preparing unsmoked sheet depends on the cost of different fuels. Firewood was considered to be the cheapest fuel up to a price of Rs. 2·50 per "yard" but above that price it becomes cheaper to dry over coke stoves or by

radiation from steam pipes using coke as fuel for the boiler. It was shown that smoke, as distinct from heat, can be produced with a very small consumption of firewood so there is no particular advantage in producing unsmoked sheet unless the manufacturer shows a preference for this grade.

It has recently been proposed in Malaya to roll sheet rubber sufficiently thin to be air dried at ordinary temperature, as a substitute for crepe rubber, and it is understood that this grade is being prepared on a few estates. The saving of fuel may compensate for the increased amount of machining, but it is uncertain up to the present whether the product will prove a suitable substitute for pale crepe for the maufacture of light coloured articles.

ALTERNATIVE FORMS OF MANUFACTURE

Hopkinson Process

The present standard methods of manufacture depend on coagulation of the latex and subsequent rolling of the coagulum. The only fundamentally different method of obtaining rubber from the latex is to remove the water by evaporation. A process for this purpose, analogous to the evaporation of milk, was developed some years ago by Hopkinson and has been worked on a large scale on the well known H. A. P. M. estates in Sumatra. The latex is sprayed in a finely divided form into a heated air chamber and the particles of rubber fall to the ground where they adhere, to form a spongy mass of rubber. This is pressed into blocks and is then ready for export.

Since the moisture is removed by evaporation it follows that the non-rubber substances present in the latex, amounting to 7-8 per cent., remain in the rubber and their presence confers both advantages and disadvantages on the product. Ageing properties are materially improved but the rubber absorbs moisture more readily and is not suitable for certain purposes. Manufacturers have had opportunities for testing this material but have shown no disposition to favour its adoption as a standard grade of plantation rubber.

No information has been published regarding the cost of this process of manufacture but it appears unlikely that it would be substantially cheaper than present methods.

Rubber Powder or Crumb

As a development of the above process an invention has recently been announced, from Holland, by which the particles of rubber obtained by spraying the latex are prevented from adhering and the rubber is obtained in the form of powder. This is an entirely novel product and claims have been made

that its use will reduce manufacturing costs in certain existing processes by eliminating mastication and will facilitate the use of rubber in various new directions, such as for road surfacing, the linoleum industry, etc. So far both the preparation and utilisation of the material are only at an experimental stage but there appear to be interesting possibilities for development. It will be noted that this product contains all the non-rubber substances present in the latex so can be expected to have the advantages and disadvantages associated with "whole latex" rubber.

Independently of the above process the London Staff of the Research Scheme has devised a method for the preparation of rubber in the form of crumb which can be put to the same type of use as rubber powder. This process involves coagulation of the latex so the product will have similar properties to the ordinary grades of plantation rubber. Samples of the material are being distributed to manufacturers and development of the process will depend on whether the product proves to have advantages over other forms of plantation rubber. It is anticipated that this method of preparation would be somewhat more expensive than crepe manufacture.

Preserved Latex

Apart from coagulation and evaporation of the latex another alternative is to market the rubber in the form of latex, suitably stabilised to prevent coagulation. The direct use of rubber latex in industry has increased rapidly in the past few years and there is every prospect of continued extension of its use, both for replacing other forms of raw rubber in certain existing processes and for extending the use of rubber in new directions.

Until recently the latex, preserved with ammonia, was shipped at the ordinary field concentration of 35-40 per cent. but various processes have been developed for concentrating the latex prior to export and two of them are being operated on a large scale in Malaya. The "Revertex" process involves the evaporation of water from the latex by heat after addition of an alkaline stabiliser, the product being a paste containing about 75 per cent. rubber. The "Utermark" process, the patent rights of which are held by the Dunlop Company, depends on the removal of water from the latex by centrifugation in a machine of the milk separator type and gives a product, similar in consistency to field latex, containing about 60 per cent. rubber. The two products differ in type since "Revertex" contains an increased proportion of serum substances whereas "Dunlop 60 per cent. latex" contains a reduced proportion. It seems likely

that the latter type of product will have the more general application in industry. A third method of concentrating latex, by adding a chemical which induces "creaming", is being tested experimentally in Malaya but so far a rubber content exceeding 45-50 per cent. cannot be relied on.

At present there is a steady demand both for ordinary ammoniated latex and for concentrate but it appears probable that the main demand in the future will be for concentrated latex, both on account of the saving in shipping costs and the fact that many of the new applications of latex require the use of the concentrated material. The Dunlop Company has indicated its willingness to issue licences for the use of the centrifugal process and enquiries are in hand regarding the supply of a machine for trial in Ceylon.

The cost of preparing ammoniated latex for shipment depends largely on the scale on which the process is worked. Small shipments of latex are usually made in kerosene tins packed in crates, the preservative being used in the form of "strong liquid ammonia". The cost of preparation and packing amounts, in this case, to 8-9 cents per lb. of rubber. If ammonia gas, purchased in cylinders, is used and the latex is shipped in 40-gallon drums the cost of preparation falls to $3\frac{1}{2}$-4 cents per lb. To these figures must be added the extra cost of shipment as compared with other grades of rubber. No figures are available for the cost of concentrating latex by the centrifugal process but it is likely to be slightly higher than that of ordinary ammoniated latex prepared under efficient conditions.

Rubber in latex form is therefore a more expensive product than crepe or smoked sheet and is only profitable to produce if it sells at a satisfactory premium over other grades. At present latex rubber sells at a premium of approximately 2*d*. per lb. on the London market so there is a fair margin if economical methods of preparation are adopted.

NEW PROCESSES AND UNIFORMITY

In an earlier paragraph it was pointed out that the main defect of plantation rubber is its lack of uniformity which could largely be remedied by standardising methods of manufacture and by bulking the latex from large areas. If any new processes of manufacture are introduced in Ceylon, such as the preparation of concentrated latex, rubber crumb or rubber powder, the writer considers it essential that they should not be adopted by individual estates but that co-operative factories should be established so that latex from considerable areas can be bulked and the method of manufacture efficiently controlled, thus assuring the production of a uniform material. The application of this

principle either to existing or new processes would do much to remove the stigma of variability which is at present associated with plantation rubber.

SUMMARY AND CONCLUSIONS

1. New processes of manufacture of raw rubber are not likely to prove cheaper than existing methods if the latter are carried out under efficient conditions. Adoption of new processes may be justified by an enhanced market value of the product.

2. The uniformity of rubber prepared by existing processes can be improved by standardisation of methods and by bulking the latex from large areas. Thin air-dried sheet has been suggested as a substitute for crepe for manufacture of light coloured articles.

3. Rubber powder and rubber crumb are novel products with interesting possibilities of development but at present both the preparation and utilisation of the materials are at an experimental stage.

4. The direct use of latex in industry has increased rapidly in recent years and continued development is expected. The main demand in the future is likely to be for concentrated latex.

5. If new processes are adopted in Ceylon it is important that co-operative factories should be established to ensure bulking of latex from considerable areas and the production of a uniform material.

REFERENCES

(1) The Rubber Research Scheme (Ceylon)—*Bulletin* 52. The Preparation of Uniform Rubber.

(2) The Rubber Research Scheme (Ceylon)—*Bulletin* 51, The Curing of Sheet Rubber.

IMPORTATION OF RUBBER BUDWOOD AND BUDDED STUMPS

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PREVIOUS CONSIDERATION OF THE PROBLEM

THE question of the danger of importing fungus diseases with rubber budwood and budded stumps arose in 1929 in connection with a disease of young bud-shoots. The fungus causing this disease was found to be a particularly virulent strain of *Phytophthora palmivora* (*P. Faberi*) which had not previously been reported in Ceylon. The first specimens of this disease were received simultaneously from two estates, the infection having developed in each case on the same Java clone. When it was ascertained that the material on both these estates came from the same consignment of budwood, and that the disease and the particular strain of *Phytophthora* were known in Java, there was strong reason to suspect that the fungus had come to Ceylon on imported material.

The matter was brought to the attention of the Technical Committee of the Rubber Research Scheme and, at a meeting held in October 1929, it was resolved that experiments should be undertaken to discover an effective and harmless means of disinfecting imported budwood and budded stumps. Attention was drawn to the fact that harmful fungi might be carried in a dormant state on budwood which was itself quite healthy, and that the most careful inspection would not reveal such an external "infection".

In this connection it is of interest to quote Resolution No. 5 of the Second Imperial Mycological Conference held in September 1929. "The Conference suggests that the attention of the Governments of Malaya and Ceylon should be drawn to the desirability of investigating the possibility of treating budwood of rubber against diseases before import".

EXPERIMENTS IN CEYLON AND MALAYA

Experiments were started in Ceylon towards the end of 1929 with a view to finding an effective and practicable means of disinfecting budwood, but unfortunately pressure of other

work has prevented these experiments being carried to a conclusion. For a full summary of this work reference may be made to a memorandum issued in July 1930, which constitutes an interim report of the work carried out up to that date, and sets forth some of the practical considerations in connection with the application of any disinfectant treatment.

Briefly stated, the most satisfactory results were obtained by dipping the budwood for 5 minutes in weak solutions of copper sulphate, this treatment being apparently both effective in killing fungal spores, and harmless to the budwood. More recent work, however has shown that clones vary greatly in their susceptibility to damage by immersion in copper sulphate, and it is now clear that this fungicide could not be used as a general budwood disinfectant, at any rate at the concentrations previously tested. It was at this inconclusive stage that the investigations had to be abandoned owing to the prior claim of other duties.

The matter of disinfecting budwood has also received the attention of the Rubber Research Institute of Malaya, and a report entitled "The Effects of Certain Fungicides on the Viability of *Hevea* Buds" was recently published in the Quarterly Journal of that Institute. The report shows that certain chemicals can safely be used for disinfecting budwood. The investigations, however, were admittedly incomplete, and the Rubber Research Institute of Malaya is not yet in a position to recommend a treatment which will be effective, harmless to all clones, and easy and cheap in practical application.

PRESENT REGULATIONS

The present regulations governing the import of *Hevea* material into Ceylon prohibit absolutely the introduction of any seeds or plants from the Western Hemisphere. In order to import material from the Eastern Hemisphere a permit in writing must be obtained from the Director of Agriculture, Ceylon, and the material must be accompanied by a certificate of freedom from pests and diseases issued by the exporting country. The Inspector, Plant Fumigatorium, Colombo, may unpack and inspect any consignment, but in the case of budwood this inspection is usually waived in order that the budwood may reach the estate with the minimum delay.

The regulations ensure that no actually diseased budwood or budded stumps shall be introduced, since the material has to be carefully inspected in the country of export. They do not, however, prevent the entry of harmful fungi which may be in a dormant state on the surface of the budwood or even in the packing material, since the most careful inspection would not

reveal the presence of resting spores or mycelium. We may enquire, then, to what extent the possibility of introducing new disease agents with imported budwood is a real danger.

DANGER OF INTRODUCING NEW DISEASES

The possibility of fungi new to Ceylon being introduced with imported budwood is exemplified by the case of the strain *Phytophthora palmivora* referred to above, though its entry in this manner cannot be more than strongly suspected. The disease caused by this fungus has unfortunately caused considerable damage in budwood nurseries during the recent S. W. Monsoon, though it yields fairly readily to control measures. Owing to its wide-spread occurrence in Ceylon at the present time this disease, however, can clearly have no bearing on restriction of future importations. It is also uncertain whether the strain of *Phytophthora* in question has been responsible for all the cases reported. The indigenous strain of *Phytophthora palmivora*, although somewhat less virulent in this country than the imported strain, is also capable of causing a die-back of green shoots under favourable conditions.

The absolute inhibition of all *Hevea* imports from the Western Hemisphere is on account of a dangerous disease known as South American Leaf Disease whose causal fungus, *Melanopsammopsis ulei*, is fortunately confined to South America. Most of the diseases which occur in the other rubber-producing countries in the Eastern Hemisphere are known also in Ceylon, though they are not of equal importance in all countries. So far as is known the only diseases of consequence which occur further East but not in Ceylon are two in number:

1. Mouldy Rot of the tapped surface caused by *Sphaeronema fibriatum*, known in Malaya and the Dutch East Indies.

2. Wet Root Rot caused by *Fomes pseudoferreus*, which occurs only in Malaya.

The introduction of these two fungi on imported budwood is possible though it cannot be considered very probable. *Fomes pseudoferreus* might occur on the roots of budded stumps but would be unlikely to pass the inspection in the country of export. (In this connection it is of interest to record that the introduction into Indo-China of budded stumps infected with certain root disease has been reported).

The possibility must also be borne in mind of a fungus, which is a weak parasite in its native country, becoming strongly parasitic and possibly dangerous under the different ecological conditions of the country to which it is introduced. Thus the fungus causing a certain disease in, say, Java may be a different

biological strain to that causing similar symptoms in Ceylon. The former, on introduction from Java to Ceylon, might become more virulent than either its counterpart native to Ceylon or itself in Java.

It is thus clear that with the present system of almost unrestricted imports the danger of the introduction of new diseases must always be present. In the last section of this report the possible methods of safeguarding the rubber areas in Ceylon against new diseases are briefly considered.

PROTECTIVE METHODS

There appear to be two means by which the entry into Ceylon of disease organisms could be prevented more surely than under existing regulations:

(1) Absolute inhibition of the importation of *Hevea* budwood, budded stumps and seed.

(2) Disinfection of all imported material.

(1) INHIBITION OF IMPORTS

Inhibition of the importation of all *Hevea* material would be a very drastic measure, clearly attended by many objections. It is only necessary to state that such a measure would preclude Ceylon growers from obtaining any of the improved planting material which will become available in Malaya and the Dutch East Indies during the next few years. It is certain that better foreign clones than those at present known will come on the market during the next few years and, until proved Ceylon material is available, budwood or budded stumps from these clones will be required for new plantings and rejuvenation. It is submitted that such a drastic action could only be recommended to Government if there was a likelihood of any disease being introduced which would be a real menace to the plantation industry. At the present time there appears to be no cause for apprehension on this account.

(2) DISINFECTION

The consideration of recommending legislation to enforce the disinfection of budwood and budded stumps before import must await results of further investigation into disinfecting methods. At the present moment no work is being conducted along these lines in Ceylon owing to shortage of staff, but it is understood that the subject is receiving the attention of the Rubber Research Institute of Malaya. In this matter it may be found desirable to follow the lead of the latter country.

It is unnecessary in this report to deal with the practical problems in connection with any disinfectant treatment. Whether the disinfecting is carried out in the country of export or

import such difficulties are not likely to prove insuperable. When a suitable treatment is found it is possible that all countries which are exporting or importing *Hevea* material may introduce regulations for disinfection. In the meantime there appears to be no special cause for fearing the introduction into Ceylon of new diseases, and, at the present juncture, any restriction placed on the import of high yielding material is to be deprecated.

SUMMARY

1. This report has been written on the instructions of the Board of Management of the Rubber Research Scheme, arising from a suggestion that the importation of *Hevea* budwood and budded stumps should be prohibited in order to prevent the introduction into Ceylon of new diseases.

2. This matter received previous consideration in 1929 as the result of the suspected introduction from Java of a virulent strain of *Phytophthora palmivora*. This fungus has since caused considerable damage to young shoots in budwood nurseries.

3. Experiments have been carried out in Ceylon and Malaya with a view to finding a method of disinfecting budwood which is cheap, easy, effective and harmless. This work has not yet reached a stage at which any definite recommendations can be made.

4. The existing regulations governing the importation of *Hevea* material constitute an adequate safeguard against the entry into Ceylon of any material on which disease has developed, but they do not ensure the exclusion of harmful organisms in a dormant state.

5. Although it is suspected that the die-back of bud-shoots caused by *Phytophthora palmivora* originated from imported budwood, this disease is now so wide-spread in Ceylon that it cannot be regarded as having any bearing on future importations.

6. There is always the possibility of new disease organisms being introduced with imported material, but there is at present no cause for special apprehension on this account.

7. There are two alternative methods of further safeguarding the Ceylon rubber industry against the introduction from other countries of new diseases.

(1) Absolute prohibition of the importation of all plants or parts of plants of *Hevea*. It is submitted that such a drastic measure could only be justified by the existence in any exporting country of a disease which, if introduced to Ceylon, would constitute a serious menace to the health of the plantations.

(2) Disinfection of all imported *Hevea* material. When a suitable disinfecting treatment is discovered such a measure may prove a desirable and practicable addition to the present regulations.

8. It is submitted that any unnecessary restriction placed on the entry into Ceylon of high yielding material is, at the present time, highly undesirable.

NOTES ON THE AFTER-TREATMENT OF BUDDED RUBBER STOCKS

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IN an article on budgrafting contributed jointly with Mr. R. K. S. Murray to the Rubber Research Scheme *Fourth Quarterly Circular* for 1931 reference was made to the practice of protecting the cut surfaces of budded stocks with a mixture of Asphalt and Kerosene. Observations made at the Experiment Station, Nivitigalakele during the past year have indicated however that the mixture is not entirely satisfactory either as a waterproof covering or as a protection against wood-rotting fungi, confirming the opinion expressed in the Annual Report of the Rubber Research Institute of Malaya for 1931. An experiment to compare various methods of treatment was initiated at Nivitigalakele in June 1932, and it is the purpose of these notes to record and comment on the results obtained so far. In doing so it may also be of interest to offer some remarks on the past history of treatment of budded stocks at Nivitigalakele in order to indicate the increasing importance which has been attached to the treatment of the cut surfaces, especially when the stocks are comparatively large.

PAST HISTORY

In the 1926 clearing which is the oldest in the Station the practice was to cut the stock down (after it had been successfully budded) to within 6 inches of the bud-patch and to leave the six inches of stock above the bud-patch, commonly called the "snag" eventually to dry and fall off. This was sometimes more expeditiously effected by kicking the snag over after it had sufficiently withered. If the stocks are young and vigorous, callusing proceeds rapidly and the treatment may prove quite satisfactory but there is obviously a risk of infection by wood-rotting fungi, which start on the decaying snag and may spread to the healthy stock and scion. The risk is likely to increase if the plants are lacking in vigour or are comparatively large at the time of budding. If a hollow is left when the snag falls off, which is not unusual, or is formed by subsequent decay, water collects and further decay is accelerated.

In the 1927 and part of the 1928 clearing the stocks were cut back to six inches above the bud-patch and a coating of wood tar applied to the cut surface. Some months later when the bud shoot had grown sufficiently to show about 2 feet of brown bark, the snag was sawn off with a sloping cut on a level with the bud-shoot and the cut surface again treated with tar. The same treament was applied to supplies which were put out to replace budding failures in the 1926 clearing.

A further development in treatment was introduced in later buddings in the 1928 clearing when tar, as a result of its lack of elasticity and liability to crack, was replaced by a mixture of Asphalt and Kerosene referred to above. In addition the cut surface, after removal of the snag, was painted with a 10 per cent. solution of Brunolinum plantarium some hours before application of the waterproof covering. The Asphalt-kerosene mixture in turn has not proved to be entirely satisfactory and has led to the series of experiments recorded in this report.

TREATMENT OF DISEASED STOCKS

Decay of the cut surfaces of budded stocks has occurred to some extent in all the clearings on the Station and early in the present season it was decided to make a tree to tree examination and to treat all infected surfaces in order to prevent further decay and to facilitate callusing of the stocks. It is of interest to note that in many cases the exposed wood surface appeared quite sound when examined superficially but careful inspection showed that the wood was soft and tindery underneath. After preliminary trials and pending more definite information from the experiments which have been initiated, the following method of treatment was adopted. All rotted tissue was scooped out down to clean wood and the surface painted first with a 10 per cent. solution of Brunolinum plantarium, and after drying, with Skene's pruning mixture. If after scooping, a hollow remained in which water could lodge, it was filled up with a mixture of one part "Colas" and two parts sand kneaded into a form of putty.

Treatment has been carried out in all three clearings but has only been completed in the 1926 clearing. Of 1,218 trees in this clearing 919 were budded in the field and 299 were budded in the nurseries and subsequently transplanted, ("supplies"). Of those budded in the field 389 were treated as described above and 530 did not require treatment. Of the 299 "supplies" 150 were treated and 149 did not require treatment.

The treated plants were divided into the following groups:

	Budded plants	Supplies
Stock (only) affected to depth of less than 1 inch	72	54
Stock (only) affected to depth of more than 1 inch	269	80
Scion (only) affected	10	0
Stock and scion both affected	38	16
	389	150

Comparison of the figures might suggest that the method of treatment has had little effect in preventing decay since the snags of most of the buddings were allowed to drop off whilst most of the supplies had the snags sawn off. It must however be remembered that supplies take some time to become fully established and would be expected to be less resistant to attack by wood-rotting fungi. A better comparison on this point can be made when figures are available for the experimental trees which are under special observation.

From the relatively large number of trees which have been treated it might be supposed that the general condition of the trees in the clearing is unsatisfactory but this is not the case. The trees are growing well and a number are already being test-tapped. Many trees which were treated had, at the time of treatment, already callused over except for a small hole in the centre in which water could lodge. The Colas filling which was applied squeezes out as callusing proceeds and the extent to which this has occurred in the past few months shows that rapid healing is taking place.

The object in presenting the figures at the present time is to emphasize the value of periodical inspection of budded plants, renewal of the waterproof cover on the cut surface of the stock and the early treatment of any which show signs of decay. The liability to decay occurs in the period before the bud shoot is sufficiently developed to maintain the vigour of the plant but once a hollow forms which can hold moisture it is difficult for the plant to resist further decay in spite of increasing vigour. Earlier treatment of the plants in this clearing would doubtless have prevented the comparatively large number of cases in which decay had extended to a depth of more than an inch.

General observation at the Experiment Station and on estates indicates that careful waterproofing of the cut surface of the stock is of considerable value in preventing decay but that the more important factor is the state of vigour of the plants. An appropriate application of a manure mixture a few months

before budding for instance will go a long way in ensuring successful callusing of the joint of stock and scion.

EXPERIMENTAL

In view of the somewhat undesirable number of budded plants which have become decayed to a greater or less extent at the snag joint a series of field experiments was undertaken in June 1932 to ascertain:

(1) how best to treat joints which had already commenced "rot" and in some cases had penetrated several inches down into the stock or up into the scion, and

(2) what form of treatment would be most effective for adoption immediately upon de-snagging in order, if possible, to prevent rot starting at all.

PART I

Layout.—Part I of the experiment was replicated in all three clearings and 12 trees were allotted to each treatment. Plants were selected from actual infected specimens (except for controls) growing in the field according as they most suited the treatments undertaken. Each specimen was marked with a tar band and its number recorded with particulars and sketches of the infected area. All plants used for the experiment had to be budded plants where stocks had already been cut down some time previously and whose scions were fairly advanced in growth, allowing sufficient time for the rot to develop. The treatments were as follows:

A. 12 untreated with cut surface of snag healthy. Control.

B. 12 untreated with cut surface of snag soft and infected. Control.

C. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium and painted with Skene's pruning mixture.

D. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, and painted with "Colas".

E. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, painted with Skene's pruning mixture, and filled with cement (1 cement to 2 sand) and shaded.

F. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, painted with Colas and filled with a mixture of Colas and sand (1:2).

Treatments E and F were carried out on joints which, after scooping out, left a hole of anything from 1 to 8 inches deep in which water could collect and treatments C and D on joints where infection was of a more superficial nature leaving no deep hollow for the accumulation of rain water.

Observations to date.—An inspection of the plants was made in Nov.-Dec., 1932 approximately 5 months after the experiment was started. The lots of control plants showed no detectable change in condition and will have to be left longer before obtaining the information that is required of them. They were included in the experiment with the idea of ascertaining whether lot A, left untreated, will in time develop infection, and whether the infection in lot B, similarly left, will tend to spread further with time. Choice between lots C and D at the present stage is difficult and observations show that both the Skene's mixture and Colas are satisfactory for the purpose for which they were used, namely for covering flat surfaces where water accumulation does not take place. The covering of Skene's mixture over the cut surface has formed into a hard, more or less impervious crust over the wood while that of Colas has subsided into a slightly softer layer. Skene's mixture however shows signs of greater adhesion, is easily applied and on the whole appears to be preferable. Colas has the advantage that it can be applied when the surface is damp. For the purpose of filling stocks containing cleaned-out holes although the cement filling in E has not proved definitely unsuitable the Colas-sand mixture in F has been considered preferable. The latter owing to its permanently soft consistency does not act as a deterrent against the closing up (by callus formation) of the hole and gets squeezed out as callusing develops. The cement, besides being unable to do this, tends on hardening to crack round the edges of the filling with the consequent danger of letting in water to the bottom of the hole and starting fresh rot. Even the provision of shade was not always successful in avoiding cracking. Moreover the "unshrinkableness" of the cement may tend to act as a definite deterrent against the speedy closing in of the hole if the filling is not done to perfection.

PART II

Layout.—For the second part of the experiment budded plants whose snags had been freshly cut down were utilised. The experiment was for this reason confined to the 1928 clearing.

The treatments were:

A. 24 plants with snags uncut. Control.

B. 24 plants with snags cut and Skene's pruning mixture applied over cut surface.

C. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and Skene's mixture applied over cut surface.

D. 24 plants with snags cut and treated with a mixture of "Entwas" wax and 5 per cent. by weight of powdered sulphur.

E. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and treated with a mixture of "Entwas" wax and 5 per cent. by weight of powdered sulphur.

F. 24 plants with snags cut, and treated with a mixture of Asphalt and Kerosene (1:1).

G. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and treated with a mixture of Asphalt and Kerosene.

Observations to date.—Here again the control group, at time of examination, had not had time to produce results, and the snags though in a more advanced stage of decay than in July (when started) were not sufficiently withered to fall off or to be kicked over. Until such stage is reached one is not able to state definitely whether leaving the snag to fall off results in wood-rot spreading from the dying snag to the healthy tissue of the stock and scion. Lots B and C again showed that the Skene's mixture had maintained the surfaces treated with it in a satisfactory condition up to the present stage and had formed the same hard crust over the wood which was described earlier. As compared with B & C, lots D & E have proved disappointing. The Entwas-sulphur layer has in many cases almost entirely disappeared from the cut surface of the stock (i.e. at the end of 4 months from application) having melted and poured down its sides, sometimes leaving a dark mould in its place. It was observed that by 10 a.m. on a hot day the mixture began to melt unless shade was provided. A further disadvantage is the formation of bubbles on the surface of the mixture a few days after application. Eventually these bubbles break leaving

exposed patches of bare wood and causing flaking away of the area immediately around them by rain. Bubble formation is caused by the exudation of sap from the surface of the cut stock and may occur even after allowing an interval of 14 days between cutting down and application of the wax mixture. Accordingly in the light of present experience and on account of the more tedious preparation of the wax mixture and the provision of shade required by it, which is not always convenient to supply, it has been decided to adopt the Skene's treatment as general practice at Nivitigalakele in preference to the wax-sulphur mixture. It should be mentioned that callus formation with the latter is very marked although the former is not deficient in this respect. It is preferable that the Skene's mixture be renewed every 6 months. Lots F & G at the present stage show no change worth recording. They were only started in August 1932.

CONCLUSION

The remarks made in this article are not intended to present a complete thesis on the treatment of stocks but rather to outline experience gained and observations made at the Experiment Station, Nivitigalakele. The experiments are still in a half-way stage and the conclusions essayed in certain instances are therefore subject to revision.

THE SELECTION OF PINEAPPLE PLANTING MATERIAL*

SINCE the inception of the present series of pineapple disease investigations in October, 1931, attention has been chiefly centred on the problem of determining the cause or causes of "wilt" and the conditions necessary for its development. "Wilt" is wide-spread and increasingly destructive in pineapple fields in Queensland and is unquestionably the most serious trouble with which growers have to contend. Field studies carried out during the past twelve months have shown that wilting of pineapple plants may arise from several different causes and that the expression of disease symptoms developing in wilt-affected fields varies according to the dominant underlying cause. In fact, on the basis of symptoms developed, it has been found possible to differentiate between three distinct types of wilt occurring in Queensland plantations, namely:

(a) Wilt due to poor drainage or other unsuitability of the soil;
(b) Wilt arising from nematode attack;
(c) Wilt disease.

The last-named type of wilt "(c)" is the one which is causing most serious concern amongst pineapple growers in Queensland at the present time.

NEED FOR CAREFUL SELECTION OF PLANTING MATERIAL DEMONSTRATED BY SPREAD OF WILT DISEASE

During the twelve months that the present investigations have been in progress, they have contributed, among other things, a fair amount of information concerning the manner in which the wilt disease is disseminated from diseased to healthy plantations. Considerable evidence has been secured which indicates that the spread of wilt disease throughout the pineapple-growing districts of Queensland has been largely brought about through the planting of suckers, slips and tops derived from diseased plantations. In particular, the indiscriminate planting of tops obtained free from canning factories—which has been carried on extensively in some districts during the last two or three seasons—appears to have contributed greatly to the serious position in which wilt has placed the industry in those areas at the present time.

OTHER ADVANTAGES ACCRUING FROM METHODICAL SELECTION OF PLANTING MATERIAL

While most growers are now fully alive to the importance of taking planting material only from healthy fields, it is not so generally realised that even in apparently healthy fields rigorous selection of planting material is necessary if the general standard of the plantations is to be maintained.

* By H. K. Lewcock, M.Sc., B.Sc., Agric., Assistant Plant Pathologist, in *Queensland Agricultural Journal*, Volume XXXVIII, Part 5, November 1, 1932.

Long-experienced growers are almost all agreed that, during the past ten years, the vitality and productiveness of Queensland pineapple plantations have shown a gradual but noticeable decline, quite apart from losses attributable to the wilt disease. This is a matter which vitally concerns every grower, as the profitable cultivation of pineapples depends not only on the price received for the fruit, but also on the yield per acre. Costs of production remain approximately the same whether the yield per acre of marketable fruit in 100 cases or 500 cases.

In view of the present depressed state of the industry, no grower can afford to ignore any economically practicable means whereby the productiveness of his plantations may be maintained or improved. Selection of planting material on a large scale is a simple and sure method not only of ensuring disease-free stock, but also of improving the whole general standard of pineapple plantations.

CHARACTERS TO BE CONSIDERED IN THE SELECTION OF PLANTING MATERIAL

In practising selection the first task is to get clearly in mind what characters of the parent plants should be perpetuated or eliminated and, secondly, to determine these characters are hereditary or due merely to the conditions under which the parent plants are grown.

(A) RESISTANCE TO DISEASE

The foremost consideration is, of course, that the planting stock shall be free from disease when planted and possess a high degree of resistance to disease infections throughout its subsequent development.

These are the criteria on which any plan or method of selection must be based. However, while the grower may practise selection primarily to secure vigorous, disease-free stock, he can, with but little additional efforts, so widen the basis for selection as to include improvement of type and increased productiveness.

With regard to the fruit itself, size and shape are the most important characters to be considered.

(B) SIZE OF FRUIT

For canning purposes, uniformly large, heavy fruit are preferred, whilst for the fresh fruit market, medium-sized fruit are in chief demand.

Only meagre data are available as to whether the size of the fruit is of a persistent character. However, the evidence at hand indicates that when selecting planting material from fields where the fruit is running medium to large in size, it is advisable to avoid plants bearing undersized fruit.

(C) SHAPE OF FRUIT

Both for canning and market purposes it is desired that the fruits should be long and cylindrical in shape, of good diameter, and possessed of flat eyes and small cores. Cone-shaped fruit are particularly unsuited for canning and abnormalities such as multiple tops also detract from the commercial value of the fruit, even when they are of fair weight. Propagation tests carried out in Hawaii indicate that the shape of the fruit is an hereditary character and plants throwing slender conical, or misshapened fruit should be avoided when selecting planting material. On the other hand

multiple tops and prominent eyes appear to be due to environment and there is no evidence at present available which would suggest that these characters are transmitted in planting material.

(D) TYPE OF PLANT GROWTH

In determining the suitability of the plant as a source of propagating material, the characters which should be looked for are: (1) general vigour and productiveness, (2) free production of suckers, and (3) resistance to disease. All growers are agreed as to the importance of perpetuating these desirable characters in their plantations. It should be borne in mind, however, that planting material should not be selected on vegetative characters alone, as vigorous growth is no guide to the type of fruit produced and lasting benefits from selection can only come from improved yields and types of fruit.

A word of caution is necessary with regard to plants throwing an excessive number of slips round the base of the fruit. This abnormality is known in Hawaii as "Collar of slips" and all the data so far available, both locally and in Hawaii, indicate that it is an hereditary characteristic. For this reason, and irrespective of their apparent vigour, all plants throwing a "Collar of slips" should be strictly avoided when selecting planting material, as such plants produce few, if any, suckers and the yield from subsequent crops is reduced accordingly. "Collar of slips" is an especially mischievous variation from type in that it offers an obvious and very easy source of planting material which would be seized upon by careless or inexperienced growers. However, provided that the "Collar of slips" type of plant is avoided, the number of slips borne (up to half a dozen) need not be considered in selecting parents from which to take planting material.

(E) SIZE OF PLANTING MATERIAL

Tests carried out in Florida by the United States Department of Agriculture indicate that only well-developed suckers or slips should be used as planting material. Other things being equal, it has been found that large-sized suckers and slips not only produce much stronger plants than undersized weak ones, but they are also likely to be freer from disease and come into bearing much more quickly. It is important, therefore, not to collect planting material until it has attained a fairly advanced stage of development.

THE PRACTICE OF SELECTION

If possible, the selection of planting material should be made only from young plants at or near the time the first fruit (plant crop) is harvested. With plants of this age it is not only easier to recognise the characters which it is desired to perpetuate but it is also possible to ensure with some degree of certainty that the planting material has been derived from wilt-free stock. In any case worn out or abandoned plantations should not be used as sources of planting material under any circumstances, as in such fields it is exceedingly difficult to distinguish between healthy and diseased plants and quite impossible to determine which plants possess desirable vegetative and fruiting characteristics. For similar seasons, the use of butts as planting material is also much to be deprecated. Furthermore, suckers and slips for planting purposes should not be taken from apparently healthy plants growing adjacent to patches affected with wilt disease, as such plants may be already infected with wilt although the symptoms are not yet evident.

Finally growers are cautioned not to purchase suckers or slips from plantations with which they are not personally familiar unless it is known on reliable authority that such plantations are free from wilt disease. Anyone who has seen the result of planting suckers or slips taken from wilt-affected plants will not henceforth be likely to use planting material from wilt-affected fields.

In order to ensure that suckers and slips are selected only from plants which meet the desired requirements of freedom from disease, vigorous and free production of suckers, combined with the production of weighty, well shaped and uniform fruit, such plants should be marked at fruiting time by dabbing a little white paint on several of the most prominent leaves. Then when the time comes to gather the planting material after the fruit has been harvested, all plants not so marked are rigidly rejected irrespective of their apparent vigour or the number of suckers or slips which they have produced.

In Hawaii where tops are used extensively for planting purposes, it is the practice to select and remove these from the fruit before they are harvested. By this practice which is possible only because of the close proximity of the Hawaiian pineapple fields to the canning factories—it is insured that all tops used for planting have been individually selected from plants and fruits of the most desirable type. Unfortunately the selection of tops in this way is not practicable under Queensland conditions, particularly during the summer months, owing to the lengthy interval which elapses between the time the fruit is harvested and its arrival at the cannery.

As previously pointed out, the indiscriminate planting of tops procured free from canning factories is a practice which cannot be too strongly condemned. In a number of instances it has been possible to definitely trace the spread of wilt disease from a field planted with tops obtained from the canning factories. While such planting material may appear to offer a cheap means of planting up an area with pineapples, it is likely to prove very costly in the long run. The origin of tops procured in this way is unknown and, quite apart from the danger of disseminating diseases, the use of such planting material should be discontinued by every grower who seeks to maintain or improve the productivity of his plantation.

DOES CONTINUED PROPAGATION FROM THE SAME STOCK LEAD TO DETERIORATION?

Many growers are under the impression that the diminution in yield and vigour of their plantations, which has become so evident during recent years, is due to their stock "running out" and that the introduction of planting material from another district will be markedly beneficial and result in greatly increased yields. On many farms the deterioration of the pineapple stock is very serious trouble, but it has resulted not so much from continued planting of the same stock as from continued discriminate propagation without selection.

Methodical and persistent selection of planting material—long recognised as being most important in maintaining yields from other vegetatively-propagated crops—is just as essential in securing the best results from pineapple-growing. Several of the most successful pineapple-growers in Queensland have been planting from the same stock for as long as

thirty years, and over this period the yields obtained per acre have increased rather than diminished. These results are largely due to the discrimination exercised in the choice of planting material. The intelligent grower realises that it pays to grow nothing but the best and that to introduce planting material from an unknown source on to his farm might jeopardise the health and vigour of his own planting stock which has taken him years of effort to bring to its present state of productiveness. Instances of the calamitous results following on the introduction of diseased planting material to previously healthy plantations have occurred all too frequently in Queensland during the past few years, as many growers can testify.

The purchase of planting stock from an old-established, productive, and disease-free plantation, for the purpose of improving the type and yield of fruit grown, is a commendable practice and one likely to benefit the industry generally; but the indiscriminate planting of stock from unknown sources, frequently from abandoned or worn-out fields, is detrimental to the interests of all concerned and cannot be too strongly condemned. Undesirable types of plants and fruits are perpetuated and, what is even more serious, diseases are frequently transmitted from unhealthy parent plants to new fields. There is no doubt whatever that many of the losses and failures experienced during recent years have been due in large measure to the indiscriminate planting of suckers, slips, stumps, and tops from weak, diseased, or worn-out plants.

From the foregoing discussion it should be evident that the advantages to be derived from careful selection of planting material are not open to argument; they are real, tangible, and practicable, as Hawaiian experience has proved beyond all shadow of doubt. The direct monetary benefits likely to accrue from increased yields should alone convince all growers of the value of the practice, but the indirect benefits resulting from the stabilisation of the canning industry with a standard quality product are likely to be even greater and more far-reaching.

SODIUM CHLORATE*

ITS USE AS A WEEDICIDE

SODIUM Chlorate is a white crystalline salt that is readily soluble in cold water, and is best applied in solution in the form of a spray. It can be used in the dry state but this method is slower in action and less economical of material, and should only be used when it is desired to treat small patches of a few square feet, or when spraying equipment is not available.

The effective strength of the solution will vary with different weeds and their stage of growth. For most weeds, particularly deep-rooting ones, a 10 per cent. solution is required, prepared by dissolving the sodium chlorate at the rate of one lb. in 1 gallon of water. Many weeds can be destroyed with much weaker solutions, even as a weak dilution as 1 per cent. The rate of application will, of course, vary according to the amount of vegetation. One hundred gallons of solution is usually sufficient to treat 1 acre of weed growth, but with weeds that make heavy growth the quantity should be increased to about 150 gallons.

METHOD OF APPLICATION

All the leaves of the weeds should be well moistened with the solution, and, as the spray is more effective and economical of material when in the form of a mist, spraying machines on the compressed air principle are the most suitable for its application. A knapsack sprayer of 2 to 5 gallons capacity will serve the purpose for the spraying of small patches, but a barrel sprayer mounted on a waggon or truck is more convenient for larger areas. When it is desired to treat several areas, power sprays as used in commercial orchards could be adapted for the purpose and would be very efficient.

For the destruction of deep-rooting weeds it is generally necessary to make two sprayings, any new growth made by the plants being sprayed about six to eight weeks after the first spraying. Unlike that of many other weedicides, which rapidly kill the top growth but do not destroy the roots, the action of sodium chlorate is very slow; at first comparatively little effect is noticed, but the plants gradually wither, the roots become exhausted, and finally the whole plant dies.

The sprayed areas should be left undisturbed for a period of three months after spraying.

BEST TIME FOR TREATMENT

The best time for spraying weeds is, as a rule, when they are in full bloom, and the action of sodium chlorate is more rapid when the air is moist. Rain following a short time after spraying does not hinder the action of the spray; in fact, in some instances the kill has been more complete when rain followed within a few hours of spraying. The chemical is not so effective on weeds which are continually in the shade, and the best results are obtained where spraying is done in direct sunlight.

* Extracted from the Agricultural Gazette of New South Wales, Vol. XLIII, Part II, November 1, 1932.

As sodium chorate is as injurious to other growing plants as it is to weeds, care is required not to let the spray solution come in contact with other plants that it is not desired to destroy, nor should it be used in close proximity to shallow rooting plants as it is likely to penetrate the soil and effect the root systems. Any spray apparatus that has been used must be thoroughly rinsed with plenty of water to remove all traces of the chemical before being used to spray fruit trees, etc.

The quantity of sodium chlorate used for the spraying of weeds has only a temporarily injurious effect on the soil. It would affect crops sown very soon after spraying; the period that must elapse before it is safe to sow crops will depend on the amount of rainfall subsequent to spraying. It has been found that crops can be safely sown during the season succeeding the application.

PRECAUTIONS AGAINST STOCK POISONING AND FIRE

Sodium chlorate is poisonous to stock if taken in sufficient quantity, and, although with the relatively small quantity of chemical used for spraying, there is little danger of stock being harmed by eating the sprayed vegetation, there is nevertheless a possibility that they may receive an overdose by licking recent-sprayed foliage. For safety, stock should be removed from sprayed areas until the weeds have been well washed by rains, and care should be taken that stock do not have access to unused spray, which they will readily drink.

Materials which burn easily, if sprinkled with a solution of sodium chlorate, are rendered more inflammable, and fine straw, clothing etc., that have been moistened with the solution and allowed to dry may be ignited by friction or from a spark, and thus constitute a fire menace. It is therefore inadvisable to prepare the solution inside sheds, and if the clothing become saturated with the solution, it should be thoroughly rinsed before being allowed to dry. Leather boots also absorb the solution readily and are not easily cleaned; therefore if large quantities are being used, it is preferable that rubber boots be worn. The wooden parts of vehicles used for conveying the solution should be painted to prevent absorption of the chemical.

SOIL FERTILITY AND MECHANISATION*

INVESTIGATIONS AT ROTHAMSTED EXPERIMENTAL STATION

THE systematic use of large scale machinery on the farm, called for convenience "mechanisation," is usually combined with a reduction in the number of live-stock kept, and hence causes certain modifications in the fertility relationships of the soil. Four important groups of problems are being investigated.

(a) Can fertility be sufficiently maintained by artificial fertilizers alone, or is it necessary to return the straw to the land in the form of manure ? If the straw must be returned what is the best way of doing it ?

(b) Is it possible to produce by any cultural process the same good effects on light land as are obtained by sheep folding ?

(c) Green manuring.

(d) Fallowing.

(a) The classical experiments at Rothamsted have shown that soil fertility can be kept at a certain moderate level by the use of artificial fertilisers alone without the use of farmyard manure. In general, however, the growth of the crop has not been enough to keep down weeds, and much expense has been entailed in cleaning. A combination of artificial fertilisers with occasional fallows, however, has proved effective in maintaining yields at low expenditure in labour but with a loss of one year in four or five. Where straw is saleable at a profit this method may be adopted. Where however straw cannot be sold—and this is the usual case—it may be converted into manure, so saving some of the fertiliser bill. This is readily accomplished where many animals are kept; the straw is simply turned into farmyard manure. The experiments show that crops obtain about 25 per cent. of the nitrogen of farmyard manure, as compared with about 50 per cent. of the nitrogen of artificial fertilisers. The recovery of potash is higher, being about 60 per cent. But on many farms the numbers of animals are being reduced and the straw must be decomposed in some other way. Investigations into the decomposition of straw have long been in hand in the Bacteriological and Fermentation Departments; four different products can be obtained according to the organisms used and the conditions under which they act:—a mixture of humic substances much like farmyard manure; pentoses; hexoses; and power gas (methane and hydrogen).

The pentoses have little practical importance; the power gas is difficult to handle on the large scale; but the hexoses are the best source of power alcohol, and this particular decomposition may prove to have considerable commercial value. For the farmer, however, the production of humus is the most important of these various changes and it has been studied in considerable detail. A method for converting a heap of straw

* Extracted from Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1930-1931.

into artificial farmyard manure by addition of nitrogen compounds, phosphate and calcium carbonate was worked out in these laboratories by Hutchinson and Richards, and developed as a large scale process by the Adco syndicate; it has been successfully adopted by large and increasing numbers of farmers and planters in Great Britain and the Overseas Empire.

Another method is now being studied: the decomposition of straw in the soil. In practice this would have the advantage of requiring less handling of the straw and thus lowering the cost of growing cereal crops. The crop would be "stripped," i.e. the ears cut off with as little straw as convenient, then the remaining straw ploughed in and allowed to decompose in the ground. The laboratory experiments show that the decomposition of the straw requires a warm temperature and a sufficient supply of nitrate or ammonium salts; if therefore the straw is ploughed into the ground in autumn while the soil is still warm and fairly rich in nitrates, the decomposition should be fairly rapid and inexpensive, seeing that the nitrates would be largely washed out if they were not utilised in this way. If, however, the straw is not ploughed in until late winter, when the soil is cold and much of the nitrate has been leached out, then decomposition is slower and may be disadvantageous to the crop by using up nitrates that would otherwise have increased its growth. Two sets of field experiments have been started to deal with these problems.

(b) *Green Manuring.*—This affords a simple method of manuring both heavy and light soils, and it requires no live-stock; it can be practised on completely mechanised farms. Its advantage in certain conditions has long been recognised, but of late years a number of instances has been recorded where it proved ineffective. The most striking is at Woburn, where, over a series of years, green manuring with tares and with mustard has failed to increase yields of wheat. Experiments carried out a few years ago on several other farms with the help of a grant from the Royal Agricultural Society of England also yielded negative results.

There are, however, undoubted successes, and investigations have been made and are still in progress to find the conditions under which green manuring is likely to give useful results. Two of the most important factors are the composition of the plants at the time of ploughing in and the time at which the ploughing is done. If the ratio C.N in the crop exceeds a certain value (usually about 20), the organisms effecting the decomposition require more nitrogen than is supplied by the crop, and so they draw on the soil nitrates that would otherwise either be washed out or taken by the plant. If, however, the ratio is less than this value, the organisms do not need the whole of the nitrogen and they leave the excess in the soil in the form of nitrate which as before is either washed out or taken by the plant. Investigations have shown that at Woburn the tares crop failed to increase the growth of wheat because it was ploughed under in autumn, and rapidly gave rise to nitrate which the wheat plant, being insufficiently developed, could not assimilate, so it was washed out, and in the following spring the wheat suffered from nitrogen starvation. The mustard assimilated nitrate and so saved it from loss, but it liberated it too slowly to be of use to the wheat. The value of nitrogen depends on the time when it is given; when given late to barley it reduces the ear tillers and the number of fertile grains and increases the vegetative tillers. It seems clear that the process of green manuring needs to be closely adapted to the soil and the crop so as to ensure liberation of nitrate only when the plant is in a position to take it up.

THE OCCURRENCE OF WATER HYACINTH (EICHHORNIA CRASSIPES, SOLMS.) SEEDLINGS UNDER NATURAL CONDITIONS IN BURMA*

I. HISTORICAL

(a) Hitherto in Burma the belief has been that the only method by which the water hyacinth propagated itself was the vegetative one, i.e. by suckers from the stems of the parent plants. In his preliminary report on *beda-bin* (*Eichhornia crassipes*, Solms.), printed in 1916, the late Mr. A. M. Sawyer, Assistant Director of Agriculture (Botany) stated, "The outstanding fact which is strongly indicated by these observations is that though the plant has distinct methods of regeneration—vegetative and reproductive—its regeneration by vegetative means so far transcends its regeneration by seed-production as to relegate the latter to a comparatively insignificant place in its development and dissemination. Even the favour of special seasons and the combination of special conditions and adaptations seem to, after all, result in the formation of but a minute quantity of seed as compared with the vast and indefinite multitude of shoots. The observations serve to confirm the impression taken at an early stage in this study that the *beda-bin*, though a sporophyte, is so in a relative and limited sense and confirms to the regenerative traditions of its family of reproduction by vegetative shoots." But he had never observed any sexual propagation in nature and had failed to get seeds to germinate. Later in the Annual Report of the Botanical Section, Northern Circle, for the year ended 30th June 1918, he further states: "No success attended experiments to germinate the seed in the laboratory. But satisfactory results were obtained in the open. On the 24th February, 1916 four single plants in fruit were thrown into a tub of water with a substratum of clay. The plants did not thrive and were pulled up and thrown away. On the 22nd August 1917, or 18 months after the plants were placed in the tub, grass-like leaves were seen appearing on the surface of the clay. These were found to be *beda-bins*. Their subsequent development was slow and they had not flowered when the year of report closed. The observations show that, compared with the propagation of the plant by suckers, its reproduction from seed is extremely slow and therefore a factor of far less importance in the multiplication of the species." From this it is quite evident that although he succeeded in obtaining seedlings under his own created artificial conditions yet he never observed the process in nature and no further record on the subject has been found except that these seedlings developed flowers but died without setting seed.

* By H. F. Robertson, B.Sc. (Edin.), I.A.S., Professor of Agriculture and Officiating Economic Botanist, Burma and Ba Thein, B.Sc., B.Ag., B.A.S., Assistant Director of Agriculture (Botany), Mandalay, in *Agriculture and Live-stock in India*, Vol. II, Part IV, July 1932.

(b) Recently attention was drawn to the matter by three publications, viz.,

(1) "Studies in Pollination and Seed Formation of Water Hyacinth", by Agharkar and Banerji (1930).

(2) "A Preliminary Note on the Physiology of the Water Hyacinth", by Parija, (1930).

(3) "An Account of a Campaign against Water Hyacinth in Orissa", by Peck (1930).

From these it was learned that seedlings had been found under natural conditions not very different from those obtaining in parts of Burma and at the request of the Director of Agriculture, Burma, enquiries were instituted.

II. OBSERVATION IN BURMA

An observer was sent to Lower Burma between the 11th and 16th May 1931, to visit Hmawbi and Pegu just after the first rains. He failed to find any seedlings and no doubt this was too soon. A keen lookout was kept all the time at Mandalay and neighbourhood and on the 10th June, two very small monocotyledonous seedlings were found in marshy ground alongside the Patheingyi Irrigation Distributory where the road from the College to the town crosses it. Their identity was in doubt though proved later, and they were transplanted with soil into a pot in the pot-culture shed. However before they developed all doubt as to their identity was set at rest by the finding of the numerous seedlings at all stages of growth in a tank on the College Farm on 26th June. These seedlings were easily identified as those of water hyacinth.

It is rather remarkable that these latter seedlings were found under practically the same conditions as the first ones in Orissa, i.e., in an isolated small constructed tank on the College Farm which dries out in the hot weather and which the senior writer had had cleared of water hyacinth on numerous occasions. On return from a year's leave he was very surprised, and even annoyed with his subordinate staff, to find it full of water hyacinth again.

After this the junior writer was sent to Lower Burma between the 2nd and 10th July and he visited Hmawbi (Insein District), Pegu and Tatkon (Yamethin District). At all places visited he found seedlings. Apparently the seeds had now had time to germinate after the break of the rains.

Further search round Mandalay revealed very few seedlings to be found in any permanent water except a very occasional one round the edges where the water had fallen during the dry season. Under suitable conditions seedlings were still being found in September and October but in reduced numbers.

III. DESCRIPTION OF SEEDS AND SEEDLINGS

(a) *Seeds.*—1·3 to 1·6 mm. by 0·6 mm. diameter, obovate, truncate at the apex, abruptly constricted to a short point at the base, with 11 to 13 longitudinal ridges; 50 to 150 brown seeds per capsule.

(b) *Leaves of Seedlings.*—The youngest stage of seedling obtained at Mandalay in Upper Burma had one green linear leaf 5 to 7 mm. by 0·8 to 1 mm., a cotyledon 10 to 13 mm. by 0·5 to 0·75 mm. and a primary root 8 to 10 mm. long.

Seedlings at this stage were brought to the laboratory and kept under observation in the pot-culture shed to determine (1) the time taken to produce successive linear leaves, and (2) the size of these leaves. The results are shown in table I.

Table I

The size of linear leaves of water hyacinth seedlings and the number of days taken to produce them.

Linear leaf of seedling	Size of leaf		Number of days required to produce these
	Length	Breadth	
	mm.	mm.	
1st	5·0 – 8·0	0 8 – 1·0	..
2nd	7·0 – 10·0	1·0 – 1·5	3 – 5
3rd	8·0 – 12·0	2·0 – 3·0	5 – 8
4th	10·0 – 13·0	3·0 – 3·5	7 – 12
5th	13·0 – 15 0	3·0 – 4·0	9 – 14

From the above it will be seen that it takes about two weeks for a seedling under conditions at Mandalay to produce five leaves. After this stage the leaves are shorter and broader and have swollen petioles indicating the presence of more aerenchyma which help the seedling when submerged to float up to the surface of water.

It has been noted however, that the size of leaves of water hyacinth seedlings varies with the climatic conditions under which they grow. Thus at Hmawbi (100 in. rainfall) in the Insein District, Lower Burma, where the climatic conditions are more favourable than in Mandalay (30 in.), the maximum sizes of linear leaves are 50 to 65 mm. by 3 to 5 mm., while at Tatkon (40 in.) in the Yamethin District these are 15 to 20 mm. by 2 to 3 mm.

It has been further noticed that when seedlings grow under submerged conditions the first leaf with a recognisable swollen petiole is formed generally after the fifth node and very rarely at the fifth node. But in the case of seedlings which are early submerged, such leaves are produced sooner, i.e., generally before the fifth node and very rarely after. This seems to indicate that under submerged conditions, seedlings developed aerenchymatous petioled leaves at a younger stage than when they are not submerged.

(c) *Hypocotyl of Seedlings.*—Observations made to determine the presence or absence of hypocotyl showed that for seedlings grown under natural conditions the hypocotyl is absent in most cases. A seed which germinated on soil at the edge of the sloping side of an earthenware pot in

the pot-culture shed produced a seedling with a clearly demarcated hypocotyl. This, together with the observations made under natural conditions, confirms the views of Parija (1930) that in *Eichhornia* "if the seed germinates on the surface and the mud is suitably moist, then there is no hypocotyl, while, if the water content falls below the required minimum, the hypocotyl is intercalated to carry the radicle down to the proper depth."

(d) *Roots of Seedlings.*—Roots are fibrous and are produced adventitiously at the base of the leaves of the seedlings. The development of the root system of seedlings at the early stage is much more vigorous and rapid than in the case of the shoot system. Thus a one-leafed seedling which takes 3 to 5 days to produce the second leaf, would within the same period have produced 5-6 roots which are longer than the first leaf.

When a seedling floats up to the surface after submersion, it generally breaks away from the root-stock, bearing with it a few short adventitious roots just above the point of cleavage, which grow and multiply quickly. Occasionally however, the root-stock also is brought up with the floating seedling and remains undetached for some time. This happens only when the soil on which the seedling grows is loose.

(e) *Comparison of seedling and sucker plants.*—When fully developed, it is difficult and almost impossible to say if a particular water hyacinth plant is formed from a seedling or from a sucker. Plants from seed produce suckers and behave exactly like those produced by suckers.

In the early stage, however, it is possible to distinguish them by the following characteristics: (1) Size of plantlets—In the case of suckers, the plantlets are much larger, i.e., sucker plantlets having only 2 to 4 leaves are larger than seed plantlets having 10 leaves. (2) Leaves—The swollen petioles and the laminae of sucker plantlets are much larger and the articulation between the petiole and the lamina is more distinct than in the case of seed plantlets. (3) Remains or scar of sucker offshoot—These can only be present in the case of sucker plantlets.

IV. CONDITIONS FAVOURABLE TO PROPAGATION BY SEED

In every case where seedlings were found, whether in Lower Burma or Upper Burma, the conditions were the same. During the dry season of the year from December to May the water in depressions had completely dried out leaving exposed the dry-baked surface which was watered again and sometimes gradually covered with water on the break of the rains in May or later. Agnes Arber (1920) writing of delayed germination in hydrophytes states "The sprouting of the seed may in some cases be deferred until the third, fourth, or fifth year, the embryo remaining uninjured by this prolonged period of dormancy. Several investigators have studied the subject of delayed germination, and the rather curious fact has emerged that this delay only occurs if the seeds are continuously immersed in water; if they are subjected to a period of drying, they germinate promptly." On no occasion were seedlings found in permanent standing water except round the edges which had dried up during the dry season owing to the fall in the water level.

The development of seedlings also seemed to be associated with the presence of decayed organic matter (e.g. decayed water hyacinth plants), and the period of maximum production of seedlings would appear to centre round the month of June. In Lower Burma owing to high and continuous rainfall it is unlikely that there will be any further production during the year, but in Upper Burma where the rainfall is low and extremely irregular there may be other batches of seedlings depending on the distribution of the rainfall in any particular season.

Apparently even where the seedlings become submerged on the rise of the water some may survive for a time and eventually detach themselves from their roots and float to the surface where they produce adventitious roots. This has been effected under artificial conditions and certainly occurred in the tank at the College Farm where the water rose to a height of a foot or more.

V. EXTENT OF PROPAGATION BY SEED

From what has been said above there can be no doubt that the extent of propagation by seed is limited when compared with the ordinary process of vegetative reproduction since the suitable conditions for the former are more limited both in area and in time, i.e. vegetative reproduction can go on practically the whole year round on the much larger areas of permanent water, whereas sexual reproduction is restricted to the one period of the year (might occur more frequently under Upper Burma conditions) and a smaller area of suitable conditions. But nevertheless there can be even less doubt that it is sufficiently extensive to cause wide re-infestation in any cleared area where suitable conditions exist and adds very greatly to the difficulty of any campaign of control.

Added to this is the possibility that the seed may possess the power of delayed germination and lie dormant for some time (Agnes Arber, 1920). Sawyer as already mentioned in second reference found seeds germinating after 18 months and the point wants clearing up.

Although actual examination has only been made in the areas mentioned, yet it can reasonably be presumed from these examples that sexual propagation of water hyacinth is general to the whole Province of Burma wherever it grows and wherever suitable conditions, as described, are to be found.

SUMMARY

For the first time the sexual propagation of water hyacinth (Vern. *beda-bin*, Bot. *Eichhornia crassipes*, Solms.) under natural conditions in Burma is recorded and seedlings described. It would appear to be general to the whole Province and though much less extensive than asexual propagation must be reckoned within considering control measures. The suitable conditions are apparently a period of drought alternating with a period or periods of plentiful moisture.

MEETINGS, CONFERENCES, ETC.

THE RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the eleventh meeting of the Board of Management, held at 11 a.m. on Thursday, November 17, 1932, in Room No. 202, New Secretariat, Colombo.

Present.—Dr. W. Youngman (in the chair), Messrs. C. W. Bickmore, C.C.S., (Acting Financial Secretary), I. L. Cameron, C. E. A. Dias, J.P., A. E. de Silva, B. F. de Silva, H. R. Freeman, M.S.C., J. L. Kotalawala, M.S.C., F. A. Obeyesekere, M.S.C., C. A. Pereira, B. M. Selwyn, E. C. Villiers, M.S.C., and Colonel T. Y. Wright.

Mr. T. E. H. O'Brien, Director of Research, was present by invitation and acted as Secretary to the meeting.

Apology for absence was received from Mr. G. K. Stewart, M.S.C.

The Chairman reported the resignation from the Board of Mr. J. D. Hoare on his departure from Ceylon on home leave. No nomination had yet been received to fill the vacancy.

ACCOUNTS

ESTIMATES FOR 1933

Draft estimates for 1933 which had previously been circulated to members were considered in detail. The Chairman invited attention to the estimate of income from cess collections (representing exports of 45,000 tons) which he considered somewhat too optimistic. He thought that a very cautious estimate of income should be adopted. It was decided to reduce the estimate for cess collections to the revised figure for 1932, namely Rs. 105,350 (representing exports of 37,600 tons). After discussion of items relating to depreciation, Bonus and Passage Fund, travelling allowances etc., and a reduction of the vote for stationery the following estimate of income and expenditure was adopted:

Estimated income for 1933	...	Rs. 113,750
Estimated expenditure for 1933	...	,, 92,339

WATCHER AT MYCOLOGIST'S BUNGALOW

The Chairman reported the appointment of a bungalow watcher during the absence of Mr. Murray on home leave and stated that the Audit Department required the Board's sanction for the expenditure. The appointment was approved.

RECEIPTS AND PAYMENTS

Statements of receipts and payments of the Board and of the London Advisory Committee for the quarters ended June 30 and September 30, 1932, were adopted.

FIXED DEPOSITS

The Chairman reported the renewal of a fixed deposit of Rs. 10,000 for one year at 4% and 2 new deposits of Rs. 10,000 each for one year at 3½%.

EXPERIMENT STATION ACCOUNTS

Statements of expenditure on the Experiment Station for June, July, August and September, 1932, were tabled. Mr. O'Brien reported that there would be slight over expenditure under certain heads of the estimates although a nett under expenditure of approximately Rs. 1,500 was anticipated. Additional votes totalling Rs. 122·50 were approved.

DEVELOPMENT OF THE RESEARCH SCHEME

The Chairman read a letter from the Hon'ble the Minister of Agriculture and Lands in reply to the resolution passed at the last meeting of the Board. It would be noted that the Hon'ble the Minister was not in a position to say that under no circumstances would money be allocated from the Restriction Fund for the purchase of a mature rubber estate. Each proposal would be considered on its merits.

After full discussion of the subject the following resolutions were passed:

1. Mr. H. R. Freeman proposed, seconded by Mr. I. L. Cameron that the Director of Research be asked to make enquiries regarding alternative estates of approximately 150 acres in area and report at the next meeting. The motion was carried.

2. Mr. B. F. de Silva proposed, seconded by Mr. C. E. A. Dias that a letter be addressed to the Hon'ble the Minister for Agriculture and Lands asking him to be good enough to state what are the circumstances under which he would be prepared to allocate funds for the purchase of a mature estate.—Carried.

EMPLOYEES' PROVIDENT FUND

After discussion of correspondence with the Income Tax Department regarding the recognition of the Provident Fund under Section 9 (1) (g) it was decided to enquire from the officers of the Scheme whether they wish the Fund to be recognised under the Income Tax Ordinance.

PUBLICATIONS

The following publications were tabled:

(a) Combined 1st and 2nd Quarterly Circular for 1932,

(b) Bulletin No. 52,

(c) Annual Report for 1931.

Discussion of other items on the agenda was deferred to the next meeting.

BOARD OF AGRICULTURE

ESTATE AND FOOD PRODUCTS SUB-COMMITTEE

MINUTES of a meeting of the Sub-Committee of the Estate and Food Products Committees appointed to consider the Memorandum of the Hon'ble the Minister of Agriculture and Lands on "the necessity for the reconstruction of the Board of Agriculture" held in the Board Room of the Department of Agriculture, Peradeniya, on Monday, November 28th, 1932, at 2.30 p.m. The Director of Agriculture took the chair.

Present.—Sir H. Marcus Fernando, Messrs. A. G. Baynham, J. Carson-Parker, R. P. Gaddum, S. Pararajasingham, C. A. M. de Silva, Rolf Smerdon, and W. A. Udugama, Ratemahatmaya.

Messages regretting inability to attend the meeting owing to illness were received from Messrs. C. Drieberg and Wace de Niese.

The Chairman in opening the meeting said that the matter before the Committee was quite plain and the purpose for which they had met was to consider the Minister's Memorandum on the reconstruction of the Board of Agriculture. The Board of Agriculture as at present constituted was made up of three Committees viz., the Executive Committee, the Estate Products Committee, and the Food Products Committee. The Executive Committee was constituted as follows:

President: His Excellency the Governor

Vice-President: The Hon'ble the Minister of Agriculture and Lands, who had taken the place of the Colonial Secretary under the new Constitution.

The Director of Agriculture, Sir H. Marcus Fernando, Sir Solomon Dias Bandaranaike, K.C.M.G., Mr. A. Mahadeva, the Chairman, Planters' Association of Ceylon, the Chairman, Low-Country Products Association, Mr. R. G. Coombe and Mr. C. E. A. Dias. The Ex-officio members were the Government Agents of the Western Province, Central Province, Southern Province, North-Western Province, and Northern Province, and the Director of Irrigation.

The Estate Products and Food Products Committees consisted of members appointed by His Excellency the Governor after nomination by the various associations and the Director of Agriculture to serve for a term of three years. In addition to the nominated members there were also certain co-opted members on these Committees.

The Chairman indicated that the Memorandum of the Hon'ble the Minister of Agriculture and Lands was briefly discussed at the last joint meeting of the Estate Products and Food Products Committees. Since then he had received a Memorandum prepared by Mr. Rolf Smerdon for circulation to the members of the Sub-Committee. He regretted it was not possible to have posted this Memorandum to those present as he had received it only 3 or 4 days before the meeting and owing to the unsatisfactory postal

arrangements at Peradeniya, he had not forwarded it to members but tabled it at this meeting. He also received the following letter from the Secretary of the Planters' Association of Ceylon:

> "At the meeting of the General Committee of the Association held on the 9th instant it was stated that at the last meeting of the Estate Products and Food Products Committees it was proposed that the Board of Agriculture, as at present constituted should be abolished. There was a lengthy discussion on the subject and I was instructed to send you the following resolution which was passed unanimously:
>
> > On the information at its disposal this Committee is of the opinion that it would be detrimental to all agricultural interests in Ceylon to abolish the Board of Agriculture. This Committee regrets that an opportunity to discuss this question was not previously given in accordance with the assurance given by the Minister for Agriculture and Lands to the Estate Products Committee.
>
> I am instructed to ask you to be good enough to forward this resolution to the proper quarters. I am also instructed to ask you what is the latest date on which you wish to receive this Association's considered comments on the matter. If you will be good enough to forward to me any information dealing with this subject I shall be grateful."

To this letter he had sent the following reply:

> "With reference to your letter of the 18th November, 1932, the Memorandum of the Ministry on the reconstruction of the Board of Agriculture was received in this office on November 4th. It was I understand already published in the Press. It was placed before the members of the combined Estate Products and Food Products Committees at their meeting on November 8th. The Joint Committee decided that a Sub-Committee should be appointed to consider the Memorandum and that another Joint Committee of the Estate Products and Food Products Committees should be held in December before the tenure of the present Committees expires, to consider the Sub-Committee's report. This Sub-Committee meets on November 28th and it would no doubt be of assistance if your Associations' comments could be considered then."

The Chairman said that he had not received any comments from the Planters' Association of Ceylon, presumably they had not had sufficient time to formulate any scheme. He had in the ordinary way submitted this correspondence to the Hon'ble the Minister of Agriculture and Lands. In this connexion the Hon'ble the Minister had asked what was the assurance of which the Planters' Association was thinking and what other opportunity do they desire to discuss the question. He also indicated that no decision had as yet been arrived at and that he would be only too happy to receive the views of the Planters' Association within a reasonable time. The Chairman said that he himself could not understand what was the assurance of which the Planters' Association was thinking and he would therefore be glad if any member could enlighten him with regard to this. It was agreed that there was some misunderstanding over this question and that the assurance referred to was no doubt that given at the last combined Estate Products and Food Products Committees meeting which had been reported in the Press.

Mr. Baynham indicated that the Minister's Memorandum had been received only early that month and that they had not had adequate time to consider it. He said that they did not desire to express an opinion in Kandy without first obtaining the views of the various District Associations and that this would take some time.

The Chairman indicated that the Memorandum should be considered early as the life of the Board terminated at the end of the year.

Mr. Carson-Parker indicated that as at present constituted the Board was too large and unwieldy and he recommended that the numbers be reduced by at least half. Mr. C. A. M. de Silva seconded the reduction of the advisory Board. The Chairman agreed that the present Board functioned rather as a debating society than as an advisory Board but indicated that he appreciated the value of the discussions which took place at the meetings of the Estate and Food Products Committees. It was agreed if a new Board was formed that the Executive Committee should be a small one to act in an advisory capacity and make any necessary recommendations from the Central Board to the various Ministries concerned.

Mr. R. P. Gaddum suggested a reversion to the state of affairs that existed after the formation of the Ceylon Agricultural Society in 1904, on the basis of Mr. Rolf Smerdon's Memorandum. There was some discussion of Mr. Rolf Smerdon's Memorandum especially on the question of proportional representation and it was decided that this would make the numbers too large. It was finally agreed that the constitution of a new Central Board be recommended—to be called the "Board of Agriculture". After further discussion regarding the constitution of the Central Board, District Agricultural Committees, and Divisional Agricultural Associations, it was finally proposed by Sir H. Marcus Fernando and seconded by Mr. S. Pararajasingham that a new Board of Agriculture be formed on the lines indicated hereunder. This was unanimously agreed to.

The Board to consist of an Executive Committee comprising not more than ten members, elected by the Board, and the Chairman (the Director of Agriculture); the Executive Committee to make representations and recommendations as desired by the Board to the Ministry of Agriculture and other Ministries for the furthering of the agricultural interests of the Island. The Board through its Executive Committee to function more in an advisory capacity than it had done in the past. The full Central Board of Agriculture to consist of a Chairman (the Director of Agriculture); 24 elected representatives, one from each of the 19 District Agricultural Committees proposed hereunder; two members elected by the Planters' Association of Ceylon, two members elected by the Low-Country Products Association, and one member elected by the Ceylon Estates Proprietary Association; 14 ex-officio members comprising: the Chairman of the Planters' Association of Ceylon, the Chairman of the Low-Country Products Association, the Directors of the Tea Research Institute, the Rubber Research Scheme and the Coconut Research Scheme; 6 officers of the Research Branch of the Department of Agriculture, one officer from each of the Departments of Irrigation, Forest, and Veterinary Services; and 10 members nominated by the Director of Agriculture, to provide for the inclusion of persons who had taken a real interest in the Agriculture of the Island and who would not otherwise be included in the personnel of the Board. The Secretary to the Board to be the Manager of the Experiment Station, Peradeniya, and

meetings to be held in the Board Room of the Department of Agriculture, Peradeniya. It was agreed that the issue of railway warrants be recommended for the use of members of the Board and that visitors should be allowed to attend but have no vote.

District Agricultural Committees to be formed representative of the respective revenue districts of the Island under the Chairmanship of the Government Agent or Assistant Government Agent with the Divisional Agricultural Officer as Secretary and to consist of members elected from the Divisional Agricultural Associations proposed hereunder. Each of these Committees to have the power to co-opt and nominate, up to a reasonable number, representatives of local agricultural industries not already represented on the District Agricultural Committee.

Divisional Agricultural Associations to be formed in each of the Chief Headmen's Divisions under the Chairmanship of the Chief Headmen and with the local Agricultural Instructor as Secretary. These associations to consist of members elected by existing and future local agricultural and co-operative societies, agricultural associations, or similar bodies; representatives of village committees and other persons with a real interest in local agriculture nominated by the Government Agents, Assistant Government Agents and the Chief Headmen concerned.

For the purpose of promoting the construction of these Divisional Agricultural Associations the formation and use of local agricultural and co-operative societies is to be encouraged, especially in areas backward in this respect where, in many cases, the constitution of the Divisional Agricultural Associations may be at first largely a matter of nomination.

The discussion concluded by the voicing of the hope that the Minister of Agriculture and Lands would utilise the services of the proposed Board of Agriculture if formed.

The meeting terminated after it had been agreed that the minutes of the meeting should be circulated to all members of the Estate Products and Food Products Committees before the adjourned meeting, which was fixed to be held on Friday, December 16th at 2 p.m.

W. C. LESTER-SMITH,
Secretary,
Board of Agriculture.

BOARD OF AGRICULTURE

ESTATE PRODUCTS AND FOOD PRODUCTS COMMITTEES

Minutes of the adjourned fifty-third meeting of the Estate Products Committee and the adjourned seventeenth meeting of the Food Products Committee held jointly in the Board Room of the Department of Agriculture, Peradeniya, at 2 p.m. on Friday, December 16th, 1932.

Present.—The Director of Agriculture (*Chairman*); the Government Agent, North-Western Province; Sir Solomon Dias Bandaranaike; Sir H. Marcus Fernando; Mr. R. G. Coombe; the Government Entomologist; the Government Mycologist; the Government Agricultural Chemist; the Director of the Tea Research Institute; the Director of the Rubber Research Scheme; the Chief Technical Officer of the Coconut Research Scheme; the Divisional Agricultural Officers of the Northern, Central, Southern, North-Western, South-Western and Eastern Divisions; the Economic Botanist; Messrs. J. P. Blackmore; Chas. Bourchier; J. Carson-Parker; V. A. de Mauny; Wace de Niese; Chas. A. M. de Silva; C. C. du Pré Moore; H. D. Ditmas; James W. Ferguson; J. Fergusson; G. B. Foote; James Forbes; R. P. Gaddum; H. D. Garrick; John Horsfall; C. Muthyah, J.P.; Mudaliyar S. Muthuthamby; Messrs. Graham Pandittasekera; S. Pararajasingham; F. A. E. Price; Gate Mudaliyar A. E. Rajapakse, M.S.C.; Mr. A. Ramanatham; Mudaliyar C. Rasanayagam; Messrs. T. Sathasivam; B. M. Selwyn; N. D. S. Silva; Rolf Smerdon; M. M. Subramaniam, M.S.C.; A. T. Sydney-Smith; E. C. Villiers; Mudaliyar S. M. P. Vanderkoen; Messrs. A. W. Warburton-Gray; H. A. Webb; M. B. Wettewe; Huntley-Wilkinson; W. C. Lester-Smith (*Acting Secretary, Estate Products Committee*) and Mudaliyar N. Wickramaratne, (*Secretary, Food Products Committee*).

Visitors:—Messrs. V. Canagaratnam; Cecil N. E. J. de Mel; C. H. Gadd; F. P. Jepson; and C. L. Wickramasinghe (Govt. Agent, N.C.P.).

Letters or telegrams expressing regret at inability to attend the meeting were received from Sir Henry L. de Mel, M.S.C., Messrs. G. Robert de Zoysa, M.S.C.; W. S. Burnett; Felix R. Dias; C. Drieberg; E. C. de Fonseka (Jnr.); A. H. Reid; J. H. Titterington; and W. A. Udugama, R.M.

AGENDA ITEM 1. RECONSTRUCTION OF THE BOARD OF AGRICULTURE

The Chairman in opening the meeting indicated that as it was an adjourned one there were no minutes to be confirmed. He indicated that at the meeting on November 8th, it was decided to adjourn the meeting and that he should appoint a Sub-Committee of five representatives from each of the Estate and Food Products Committees to consider and submit proposals which were before them that day regarding the reconstruction of the Board of Agriculture and the form in which it should continue. In accordance with their wishes he had nominated the following to form a Sub-Committee, with himself as Chairman: Sir H. Marcus Fernando; Messrs. A. G. Baynham; J. Carson-Parker; Wace de Niese; C. A. M. de

Silva; C. Drieberg; R. P. Gaddum; S. Pararajasingham; Rolf Smerdon; and W. A. Udugama, R.M. The Sub-Committee had met on November 28th and formulated a scheme, copies of which had been sent to them.

In opening the discussion the Chairman stated that the chief business to be done that afternoon was to hear opinions and criticisms and to come to some decision as to whether they would accept the scheme proposed by the Sub-Committee in its present form, in a revised form, or put forward an entirely new and different scheme. From what he had heard he believed that there was a unanimous desire that the Board of Agriculture should continue in some form. There was no doubt that in the past a considerable interest had been taken in their discussions and that the opportunity provided for members to come together and air their points of view upon agricultural topics had been very valuable. Personally he would be extremely sorry to see this opportunity cease and he considered that everyone else would feel the same but he desired to point out that in the past they had rather overlooked the fact that the Board of Agriculture was charged with definite advisory functions and that some of their difficulties had arisen because they had tended to overlook that fact. The Board really was an advisory body for the agriculture of the Island and it certainly consisted of the largest body of experts on agricultural matters that it was possible to get together in Ceylon and as such he was sure it was capable of being very valuable.

The Chairman then indicated that he considered that the advisory function of the Board had been rather overlooked in the past as the chief advisory part of it, which should have been the Executive Committee, had not functioned as much as it might have done. The proposal put forward by the Sub-Committee that there should be an Executive Committee elected from among the members of the Board would to a large extent remedy that point, and, if the Board continued, the great need of sound constructive criticism and advice was a point that they should not overlook in the future.

After reviewing in detail the proposals put forward by the Sub-Committee the Chairman requested the fullest criticism and suggestions for alterations or improvements which could in any way help in the constitution of a constructive Board of Agriculture which would be of even greater use to the Island at the present time than had been the case in the past. Free discussion was then invited.

Mr. N. D. S. Silva in connection with the proposed Divisional Agricultural Associations inquired how they could overcome the handicap of having only junior advisory officers on these Associations who would not be in touch with the policies of the departments they represented.

The Chairman indicated that the idea was rather that these officers and the chief headmen should impress prominent agriculturists in their areas into being nominated to the Divisional Associations and that the growth of such associations was a question of time.

Mr. Huntley-Wilkinson asked what exactly would be the function of the Central Committee of the Board and how often and at what intervals it would sit.

The Chairman indicated that its function would presumably be exactly the same as that with which the present Board was charged, that of advising upon agricultural matters. How often they should sit was a matter upon which they might put forward suggestions.

Mr. A. T. Sydney-Smith then proposed "that the principle of reconstruction on the basis of the Sub-Committee's report be approved provided that some form of the existing Estate and Food Products Committees be retained with as wide representation as at present, meeting bi-monthly for the purpose of discussing agricultural problems." He indicated that the proposals contained in the report of the Sub-Committee and the Minister's Memorandum went far to meet the changing conditions of the country, and, that his resolution was also the resolution of the Planters' Association. He stressed the view that for agriculture, territorial representation would not provide representative views on the subject; he considered that it was people who really thought things out that they wanted, that it was the landowners and the representatives of the goiyas they wanted on the Committees, so that every aspect of agriculture should be fully represented.

Mr. R. G. Coombe speaking in support of the resolution hoped they would be able to see their way to meeting the desire of the Planters' Association of Ceylon in this respect. Touching on the earlier history of the Estate Products Committee when it used to meet at Gannoruwa he pointed out that it had claims to be a means of inter-communion between the various masses representing the agricultural interests of the Island. That it had been one of its brightest features that they had been able to meet on common ground and discuss matters of vital interests to themselves and this country. With regard to the village committees he wished that he could feel there were some prospects of success in the suggestions put forward but he had had experience of these committees, and in association with Mr. N. D. S. Silva on one of these they had been trying to improve the agricultural conditions of the villager who was the person they should endeavour to help as much as they could. He suggested, however, that as long as the present headmen system continued there was very little hope of improving the outlook and prospects of the villager.

Mudaliyar N. Wickramaratne referring to the recommendations of the Sub-Committee suggested that the non-provision of places for the Government Agent and representatives of the Co-operative Department and the Medical and Sanitary Services on the Central Board were shortcomings. He emphasised the fact that the villager should be provided with the means of conveying his views to the District Agricultural Committees and from these to the Central Board. He expressed disagreement with the views of Mr. R. G. Coombe regarding the village headmen. While they were admittedly not all good they could not condemn them all on this account; they could not abolish the headmen system for the sake of agriculture, they should improve and reform the system.

Mr. Bruce Foote supporting the remarks of Mr. Sydney-Smith and Mr. R. G. Coombe emphasised the value of the two existing Estate and Food Products Committees as a means of liaison between the Research Institutes and the Scientific Staff of the Department. It was the only opportunity provided for planters both European and Ceylonese to meet each other and the scientific staffs for the purpose of discussing agricultural problems. To weaken the present Committees either in numbers or in

personnel he considered would deprive the Department and agriculture generally of a large number of interested men. The proposals of the Sub-Committee did not appeal to him and he considered that it would be a long time before the Divisional Agricultural Associations would be of any use.

Mr. Rolf Smerdon indicated that the presence of visitors had been envisaged by the Sub-Committee but that this would again expose it to the charge of being a debating society so he asked why dissolve the present form of Committees. The main objection to them appeared to be that they were too large to do any constructive work, why then should not the Board elect two Executive Committees and remain otherwise as at present ?

The Chairman expressed the fact that the Sub-Committee had been unanimous that the Executive Committee should be elected by the Board about the continuance of which, in some form, they were agreed. The views of the Sub-Committee and his own were that they should have an Executive Committee to keep the advisory aspect of the Board very prominently to the fore. A second point was that they should make provision for representation of village organisation on the Board. The village was bound to become more prominent in agriculture and in agricultural politics in Ceylon in the future; its growth might be slow, and, whether they brought in village organisation at once or as it found its feet and gained in status agriculturally, was immaterial provided that it was made possible for village agriculture to be represented on the Board. Village agriculture was undoubtedly backward at present and in many cases not capable of sending any representatives to such a Board but in its construction they should make room for the village agriculturists so that as they developed they could come into the Board and express their views.

Mr. E. C. Villiers considered that it was more desirable to mould the existing Board to enable village interests to come in as they became available and to get the proposed district and village committees started before doing away with the existing Food and Estate Products Committees. He suggested starting at the foundation by educating the villager and that when representatives could come forward they would be thoroughly welcome on the present Committees and in this way the object aimed at could be gradually achieved.

Dr. R. V. Norris in asking how often under the present constitution the Board and the Executive Committee met, indicated that he felt that the weakness of the present position was due rather to the non-utilisation of existing machinery. He thought the Executive Committee might function in two ways; by passing on to the Minister the results of discussions at meetings and bringing up subjects for discussion.

The Chairman indicated that during his tenure of office the Executive Committee had met twice. He felt that there was no great need to destroy the constitution of the Board but that if the Executive Committee could be reconstituted in some way so as to make it an elected committee this would assist in achieving the aims of the Sub-Committee. With regard to the number of times the Estate and Food Products Committees had met, they were supposed to meet six and four times a year respectively and any lapses were due to insufficient agendas. It was because of this last difficulty that he had conceived the idea of holding joint meetings of the two Committees and he considered that this was a wise move and had been

generally appreciated. He felt that it was a general desire of both Committees that they should continue in the future and he believed there was no necessity for separating them in future. Their joint association had brought in village representation to a small extent though perhaps not so fully as might be desired.

In answer to questions by Mr. Huntley-Wilkinson the Chairman stated that the Executive Committee as at present constituted had no Chairman but that His Excellency the Governor was the President and the Vice-President was now the Hon'ble the Minister of Agriculture and Lands.

In reply to Mr. Carson-Parker the Chairman indicated that the present Board expired at the end of this year and that automatically the Committees connected with it terminate.

Mr. R. G. Coombe intimated that the Board did not expire at the end of this year but that only the members of the present Board go out of office, the Board itself as constituted by the Ordinance did not cease to exist. The Chairman admitted that this was the correct interpretation and Mr. R. G. Coombe suggested for the present that the Board should not be abolished.

Mr. Wace de Niese supporting Mr. Villiers' suggestions feared that the Ordinance would have to be amended if it were to be adopted. If the Minister did not choose to nominate the personnel of the Board then it did expire without the repeal of the Ordinance, it was simply prevented from being brought into being.

Mr. Subramaniam agreed with Mr. Coombe that headmen should have no opportunity of controlling village agricultural committees. With regard to the present constitution of the Board he agreed entirely with some of the speakers that there should be no anxiety in the minds of members that certain interests were represented on the Board to the detriment of others. As far as he could see, the planting interests generally had not been against the interests of the indigenous population.

Mr. Bruce Foote, in connection with the remarks of Mr. Villiers and Mr. Coombe, asked for some assurance regarding the position of the Board on December 31st. Were fresh members going to be appointed, would there be a hiatus until a new Ordinance came in, or would the present Ordinance be flouted ?

Mr. Muthyah supported Mr. Subramaniam.

Mr. T. E. H. O'Brien suggested that the present Committees should go on as at present until the various local bodies proposed had been formed and were in a position to nominate representatives to the Board.

In reply to a question by Mr. Huntley-Wilkinson the Chairman said there was nothing in the Ordinance so far as he could see to prevent them from altering the Executive Committee so as to make it more advisory and that the Sub-Committee had this in mind. The Executive Committee could be elected by the other two Committees. If the recommendations of the Sub-Committee and the resolution before them were accepted it would presumably mean a new Ordinance.

Mr. Bruce Foote indicated that they were practically unanimous that they should continue as they were; the only amendment required to the Ordinance would be to alter the constitution of the Executive Committee and provide for the institution of village committees.

Some discussion over the present or a new Ordinance ensued on a motion by Mr. E. C. Villiers to which Sir Marcus Fernando, the Chairman, Mr. Carson-Parker, Mr. Subramaniam, Mr. R. G. Coombe, Mr. Wace de Niese, Dr. R. V. Norris, Mr. R. P. Gaddum, Mr. Bruce Foote and Mr.

Sydney-Smith contributed. The latter stressed the desire of the planting community to assist the Minister of Agriculture in every way to achieve his object of obtaining greater representation for village interests on the Board and to help him in the work that he was doing for the country. Mr. E. C. Villiers' resolution was finally unanimously accepted in the following terms: "That nominations and appointments to the two Committees be gazetted from January 1st, 1933".

After further discussion contributed to by Messrs. N. D. S. Silva, Sydney-Smith, E. C. Villiers, J. Fergusson, the Chairman, Bruce Foote, H. D. Garrick, James Forbes, Carson-Parker, Huntley-Wilkinson, Pararajasingham and Dr. Norris, Mr. James Forbes proposed that: "This Committee is of the opinion that District Agricultural Committees and Divisional Agricultural Associations should be formed in terms of the Sub-Committee's Memorandum of November 28th, 1932 and that provision be made for the representatives of these bodies to be co-opted on to the Board, and that the Minister be apprised of the desire of the Joint Committees to co-operate in every way possible with his requirements".

Mr. N. D. S. Silva seconded and the motion was carried unanimously.

Mr. Huntley-Wilkinson then proposed: "That provision be made for the Executive Committee to act in an advisory capacity".

Mr. F. A. E. Price seconded and the motion was carried unanimously.

AGENDA ITEM 2. FORMATION OF A MARKETING BOARD

The Chairman indicated that the Minister desired some information on the question of marketing estate produce with regard to the proposals for the formation of a Marketing Board.

Mr. H. A. Webb said that the proposal was that there should be a Marketing Board formed in two sections, one to deal with local produce of estates and the other to deal with produce exported overseas. The section concerned with overseas trade would have to be initiated by the Planters' Association and the Ceylon Estates Proprietary Association, and the local organisation by the Minister of Agriculture. The whole object was to help producers and especially the small producers of Ceylon to sell their produce without loss instead of being victimised by the middlemen as at present.

Mr. Carson-Parker requested a little more time to consider the matter. The Chairman said that the matter was one of considerable importance and the Minister desired the views of the planting industry in connection with planting products.

Mr. B. M. Selwyn stated that though he was not in a position to put forward a definite recommendation at present the Planters' Association hope to offer suggestions after further consideration of the matter. In reply to a question by the Chairman, Mr. Selwyn said that his remarks might be taken as a statement coming from the Planters' Association.

AGENDA ITEM 3. VOTE OF APPRECIATION OF MR. T. H. HOLLAND'S WORK AS SECRETARY

Mr. Bruce Foote indicated that many of them had not realised that the previous meeting was the last occasion on which Mr. Holland would be with them and he felt sorry that they had not remembered to express some appreciation of Mr. Holland's work while he was there to hear it himself. He proposed: "That this Committee desires to express its sincere appreciation of the services rendered as Secretary by Mr. T. H. Holland over a

large number of years and to convey its good wishes to him". He pointed out how courteous and helpful Mr. Holland had been and that they all felt they had lost a very able and efficient Secretary and the Department a most capable officer.

Mr. Wace de Niese rising to second the motion confirmed the fact that they were not aware that Mr. Holland would be terminating his official career after the last meeting and that they were sorry to have lost the opportunity of conveying their thanks to him and their appreciation of his good work. He commented on the fact that Mr. Holland was always cool and collected and accepted any criticisms made at meetings regarding his experiments. His exceedingly pleasant and engaging manner was always appreciated by them and he had great pleasure in seconding Mr. Bruce Foote's proposal. This was carried unanimously.

In reply to Mr. Bruce Foote the Chairman promised to convey their good wishes to Mr. Holland.

AGENDA ITEM 4. SUPPLY OF MANURE ON CREDIT TO PADDY CULTIVATORS

Mr. Wace de Niese stressed the necessity for the Agricultural Department to keep stocks of manures at various centres in the Island for sale in small quantities to paddy cultivators on terms of credit.

Mr. Muthyah spoke in support of the motion of Mr. Wace de Niese.

The Chairman stated that he was entirely in sympathy with the proposal but that there were certain difficulties such as the views of the Auditor General on credit sales, and the fact that the application of chemical fertilisers to paddy was not an economic proposition in some parts of the Island on account of transport charges. He expressed the view that the matter was mainly one demanding co-operative action and that the solution lay in the formation of co-operative societies for the supply of fertilisers. Where chemical fertilisers were not economic it was their policy to go in for, and to recommend the construction of, compost pits for the concentration of cattle manure and all material of a nitrogenous nature for application to the fields. The Agricultural Department was doing everything it could for the villager in connexion with use of fertilisers and manure.

Mr. Wace de Niese, after commenting on the fact that the class of villager they had in mind was poor and could not generally afford to be a member of a co-operative society, and after having been supported by Mr. Muthyah and Mr. Subramaniam proposed "that every facility should be given for the supply of fertilisers to paddy growers in suitable areas."

This was seconded by Mr. Muthyah and carried unanimously.

AGENDA ITEM 5. TEA RESTRICTION, TEA PROPAGANDA AND TEA MARKETING

Time did not permit of this item being taken up.

W. C. LESTER-SMITH,
Acting Secretary,
Estate Products Committee.

N. WICKRAMARATNE,
Secretary,
Food Products Committee.

MEMORANDUM ON THE NECESSITY FOR THE RECONSTRUCTION OF THE BOARD OF AGRICULTURE

"The prosperity of Ceylon depends largely on the development of its agricultural resources and the advancement of its agricultural industries." In these pithy words Governor Manning expressed in 1921 to the then Secretary of State for the Colonies the keynote of his agricultural policy. It will be remembered that the rice famine was then fresh in the minds both of the Government and of the people. There was a general feeling that Ceylon could not with due regard to her safety, follow a policy of drift that might lead her to unexpected starvation, but that she should take active steps to promote alike the planting industries under European and indigenous capitalists as well as the industries of the village population consisting of paddy and other home products. With this object in view it was decided to constitute the Board of Agriculture. The Board was expected to "bring the Department of Agriculture into the closest touch with the problems and needs of all classes of agriculturists in order that the Government may be able to secure guidance, assistance and advice from a body of practical agriculturists representative of the whole industry".

2. The Board was a purely Advisory Body and was constituted under legislative enactment (No. 37 of 1921) which itself made provision for the establishment of the Department of Agriculture. The Board was to consist of the Governor (as President) the Colonial Secretary (as Vice-President), eight official members, two unofficial members of the Legislative Council and not more than seventy members to be appointed by the Governor on the nomination of such bodies as he recognised to be representative of the Agricultural Industries of the Island or on the recommendation of the Director. It was the duty of the Board to advise on all matters and questions referred to it by the Governor or the Director. It was also within the competence of the Board to make recommendations on their own initiative on all agricultural topics. It was to meet twice a year. But as the Board was rather unwieldy there were to be three Statutory Standing Committees with a more manageable number of members. Thus came into existence the Executive Committee of the Board of Agriculture, the Estate Products Committee and the Food Products Committee. The Board and three Statutory Committees have functioned for the last eleven years.

3. It has already been indicated that the Board of Agriculture was to be representative of both the capitalist industries as well as the village industries. The former were easily and readily represented in the first Board on the nomination of the Planters' Association (9), Estate Proprietary Association (2), and the Low-Country Products Association (9). The latter were represented on the nomination of the Agricultural Society (7) and the District Food Production Committees (19). But before the expiry of three years, which period was the life of each Board, the Agricultural Society had ceased to do work; while the District Planters' Associations desired more and direct representation. In the result when the Board was reconstructed in 1923, the representation of the Planters' Association was increased in number while that for the village cultivator ceased to be adequate. These arrangements have continued to the present day practically unaltered.

4. In the meanwhile, separate Research Institutes have been created for the three major industries, tea, rubber and coconuts. And more recently a Tea Propaganda Board has also been created under an Ordinance. These several institutes and the Board can safely be entrusted with the duty of promoting the interests of the major agricultural industries of the capitalists. The Board of Agriculture has thus become a superfluous body in so far as the welfare of these industries is concerned but they may furnish the Board with information and advice which may be of great value to the village industries. It seems therefore necessary for village industries to be better represented in any board that may replace the present Board of Agriculture. I have already received representations on this question.

5. These representations have to be viewed in the light of the new Agricultural Policy under which the needs of the village peasant are to receive a greater measure of attention than in the past. It would thus appear to be desirable to reconstitute the Board of Agriculture at the expiry of the term of the Board now functioning.

6. The question thus resolves itself into (when the facts are admitted) how best may the Board of Agriculture be reconstituted in order to make it serve more effectively the purpose for which it was created. It has been suggested that there should be in each Revenue District a District Agricultural Board consisting of the elected representatives of Village Committees, the elected representatives of the District Planters' Associations, the representatives of the State Council for the Constituencies in the District, the Chief Headmen, the Agricultural Officer, the Irrigation Officer, the Forest Officer, the Co-operative Societies' Officer, all to meet under the Chairmanship of the Government Agent. The District Agricultural Board will elect representatives for the Board of Agriculture. When the District Agricultural Boards are properly organised they will automatically serve not only to consider questions of policy and execution for a particular district but also to disseminate such knowledge among the cultivators as the research and technical officers would wish to pass on to them. On occasions the Executive Committee of Agriculture and Lands may consult the Central Board. The Central Board will no doubt carry out the present duties and consider questions which may be referred to it by the District Agricultural Board. On the Central Board the Research Institutes and Propaganda Bodies will no doubt have their nominees. Further the District Agricultural Boards will be able to secure a greater degree of co-ordination and co-operation than has been possible hitherto among the officers of Government whose duties relate to the cultivation of land. They can also place before the Ministry of Agriculture and Lands proposals that will tend to further the agricultural development of the district. A second suggestion has been made. It has been proposed that there should be a separate Control Board for the promotion of paddy cultivation and food products, with District Boards, if necessary.

7. I would welcome your comments on the above proposals or any suggestions from you for any alternative proposal. This memorandum is intended as a preliminary sketch to elicit the views of those who are directly engaged in their official capacity to improve the agricultural industries of Ceylon.

D. S. SENANAYEKE,
Minister of Agriculture and Lands.

Colombo, 31st October, 1932.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31 DECEMBER, 1932

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1932	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	322	9	321	1	...	...
	Anthrax	...	...	...	...	..	...
	Rabies (Dogs)	27	3	...	2	...	25
	Piroplasmosis	...	...		...	...	...
Colombo Municipality	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	412	16	381	18	13	...
	Anthrax	30	...	...	30	...	...
	Rabies (Dogs)	39	7	...	...	...	39
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	
Cattle Quarantine Station	Rinderpest		...	...	...	...	...
	Foot-and-mouth disease	509	25	429	78	2	...
	Anthrax (Sheep & Goats)	487	11	...	487	...	...
Central	Rinderpest	1606	...	326	1248	...	32
	Foot-and-mouth disease	207	...	203	4	...	...
	Anthrax	5	5	...	5	...	..
	Black Quarter	8	...	...	8	...	...
	Rabies (Dogs)	1	...	...	...	...	1
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	32	...	32	..	..	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	...	...	..	...	1
Northern	Rinderpest	26	10	1	24	...	1
	Foot-and-mouth disease	145*	...	139	6	...	...
	Anthrax	...	...	...	...	...	..
	Black Quarter	..	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Eastern	Rinderpest	...	...	...	...	..	...
	Foot-and-mouth disease	478	478	283	4	191	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	60	...	5	46	...	9
	Foot-and-mouth disease	222†	...	207	15	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (a bull)	1	..	...	...	...	1
North-Central	Rinderpest	6681	223	1149	5279	75	178
	Foot-and-mouth disease	...	...	...	..	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	..	...	...
	Foot-and-mouth disease	6 Outb	reaks.				
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Sabaragamuwa	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	526	...	519	7	...	...
	Anthrax	..	...	...	...	...	...
	Piroplasmosis	4	...	4	...	...	...
	Haemorrhagic Septicaemia	78	...	12	66	...	...
	Rabies (Dogs)	2	1	...	...	...	2

* 50 cases occurred among Goats.

† 21 cases occurred among Goats.

G. V. S. Office.
Colombo, 11th January, 1933.

MARTIN WIJAYANAYAKA,
Acting Govt. Veterinary Surgeon.

METEOROLOGICAL REPORT
DECEMBER, 1932

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	85·4	−0·2	71·7	−0·8	74	93	5·4	5·73	12	+ 0·09
Puttalam -	84·6	−0·2	71·0	−0·3	78	95	5·7	6·10	17	− 0·09
Mannar -	82·1	−1·7	74·1	−0·8	80	88	7·0	5·89	17	− 1·92
Jaffna -	82·3	+0·1	72·5	−0·2	81	93	5·8	14·53	20	+ 4·02
Trincomalee -	80·8	−0·6	73·9	−0·6	81	88	5·5	10·78	21	− 2·96
Batticaloa -	82·3	−0·1	73·2	−0·4	78	90	4·8	12·00	23	− 4·46
Hambantota -	84·3	+0·2	72·0	−1·0	74	90	4·6	3·77	13	− 1·66
Galle -	84·1	+0·3	72·8	−0·3	76	90	5·2	2·80	10	− 3·97
Ratnapura -	88·1	−0·3	71·0	−0·8	79	90	5·9	9·21	16	+ 0·26
A'pura -	83·0	−0·4	70·5	+0·5	79	95	7·8	5·59	20	− 3·08
Kurunegala -	86·0	−0·4	69·1	−1·9	71	95	5·8	1·69	9	− 5·31
Kandy -	82·4	−0·5	67·3	−0·3	69	85	4·9	4·34	11	− 4·51
Badulla -	76·7	−0·3	63·2	−1·7	80	94	6·4	8·59	19	− 3·64
Diyatalawa -	72·5	+0·4	57·6	−0·9	79	91	7·2	5·12	16	− 2·90
Hakgala -	66·5	−1·9	50·9	−2·5	84	93	6·4	7·38	19	− 6·05
N'Eliya -	67·4	−1·0	46·5	−2·7	70	90	5·4	3·29	14	− 5·10

The rainfall of December was nearly everywhere below average, deficits being most marked in the eastern half of the Island, particularly on the eastern slopes of the central hills where several stations were more than 10 inches in deficit and two stations St. Martin's and Hendon as much as 24·83 inches and 17·25 inches below average. The majority of stations in the Island registered deficits of between 2 inches and 10 inches for the month.

Only two stations Kankesanturai and Point Pedro, both in the Jaffna Peninsula, recorded excesses of over 5 inches. A few stations in the Western Province recorded excesses of between 2 and 5 inches, while trifling excesses were registered at about a score of stations in the western half of the Island.

The highest total of 17·54 inches for the month was recorded at Kanakarayankulam. The only other stations recording over 15 inches for the month were St. Martin's, Hendon and Iddemekelle in the Central Province, Keenakelle in the Uva Province, and New Tirrukkovil in the Batticaloa District.

A few falls of over 5 inches in a rainfall day were recorded at stations in the Jaffna Peninsula on the 11th-12th, the highest being 7·00 inches at Point Pedro. Arachchi Amuna and Kirama in the South also recorded over 5 inches in a rainfall day on the 4th-5th.

Temperatures were on the whole below normal, deviations from average being generally very slight, while humidity and cloud were both above normal. The general direction of the wind during the month was north-easterly.

D. T. E. DASSANAYAKE.
Actg. Supdt., Observatory.